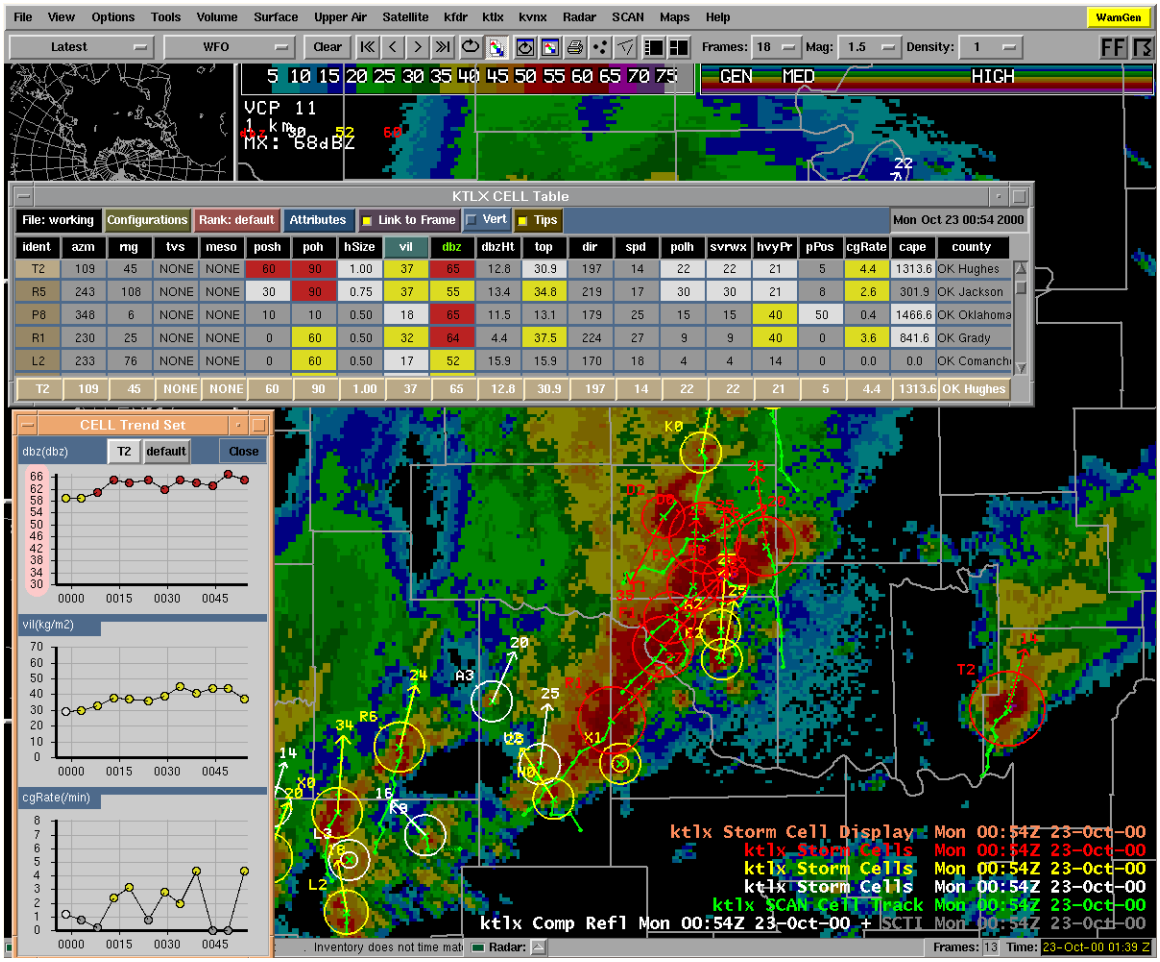
AWIPS Build 5 Enhancements for Short-Term Forecasting and Warning



Presented by the Warning Decision Training Branch

Version: 0012

Overview

Disclaimer: This student guide is ***not*** official AWIPS documentation. Official Release Notes and other documentation are posted at the NWS AWIPS "One-Stop Shopping" site:

`http://www.nws.noaa.gov/modernize/index5.html`

One or more copies of the Build 5.0 User's Manual should be available on site by the time the software is installed.

System for Convection Analysis and Nowcasting (SCAN)

SCAN is a tool to aid forecasters in the process of monitoring for the potential of severe convection. One of the goals of SCAN Version 2.0 is to mitigate the information overload that can sometimes overwhelm the forecaster. For example, SCAN can provide guidance to compel the forecaster to investigate certain storms more closely.

Flash Flood Monitoring and Prediction (FFMP)

FFMP is the flash flood counterpart of SCAN Version 2.0 that supports the forecaster in monitoring an event for potential flash flooding. WSR-88D rainfall estimates are compared to flash flood guidance, and the forecaster is given visual cues as the rainfall estimates approach or exceed the flash flood guidance values.

Data Monitoring System for SCAN and FFMP

The Data Monitoring Systems (DMS) display the availability of SCAN and FFMP inputs.

Radar Enhancements

Improvements in radar data include better functionality with respect to polar grid centering, cursor readout information, V_r Shear display features, and radar mosaics.

Satellite Enhancements

Build 5.0 adds four new hourly GOES Sounder Digital Product Imagery (DPI) products:

- Lifted Index (LI)
- Total Precipitable Water (TPW)
- Cloud Top Pressure
- Surface Skin Temperature

Future

What's coming up next? IFPS, Build 5.1.1, ORPG, Build 5.1.2. and more.

System for Convection Analysis and Nowcasting (SCAN)

SCAN provides extensive information on radar-derived storm cell parameters, such as location and movement, TVS, Meso, output from the Hail Detection Algorithm (POSH, POH, and Hail Size), VIL, and many others.

How SCAN Works

SCAN utilizes the data server (DS1), application server (AS1), and the display workstation (WS) to process and display the data (see Fig. 1). The first

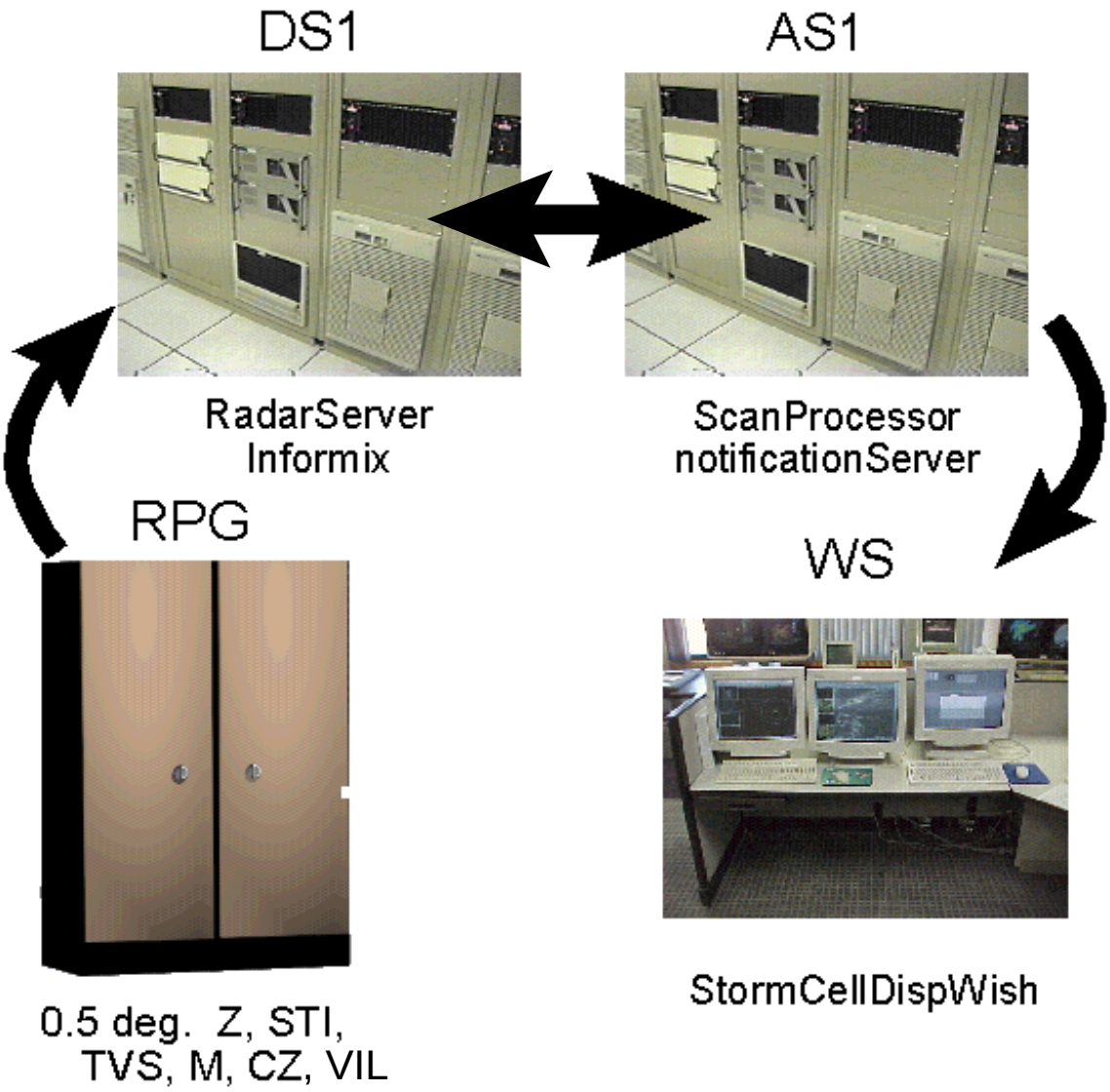


Figure 1. System layout.

step in processing data for SCAN involves the RPG sending the six radar products (CZ, TVS, M, STI, VIL, and 0.5° Z) to DS1 in the standard AWIPS radar data processing. The *RadarServer* on DS1 helps process the radar data, and it sends a notification of the new product arrival to the *notificationServer* running on AS1. The *notificationServer* notifies the *ScanProcesso*r on AS1 which accesses the radar products and writes the information needed for SCAN to four tables in the *scandata* database part of Informix (cellxxxx, tvsxxxx, mesoxxxx, sitemsgxxxx where xxxx is each radar specified (e.g., keax) in the *RadarsInUse.txt* file used in localization). After the SCAN information is written to the Informix database, the *notificationServer* notifies each WS that new SCAN data are available.

To view a radar's SCAN output in a cell table window on a particular WS, the user selects the corresponding Storm Cells/Site Storm Threat from the SCAN menu in the D2D session (see figure 2 on page 6). This request uses *stormCellDispWish* to generate a cell table window outside of the D2D session. (See Fig. 3.) The primary CPU usage on a WS by SCAN occurs when a new cell table window is created at different product times. **The information in the cell table window comes from the Combined Attribute Table (CAT) in CZ products, netcdf lightning files, LAPS files, and MDL-developed algorithms.** The TVS file data are used to display the SCAN TVS table launched from the cell table. The Meso file data are used to display the SCAN Meso table also launched from the cell table.

SCAN Storm Cell Table

The SCAN Storm Cell Table contains a myriad of information for each identified storm (see Fig. 3).

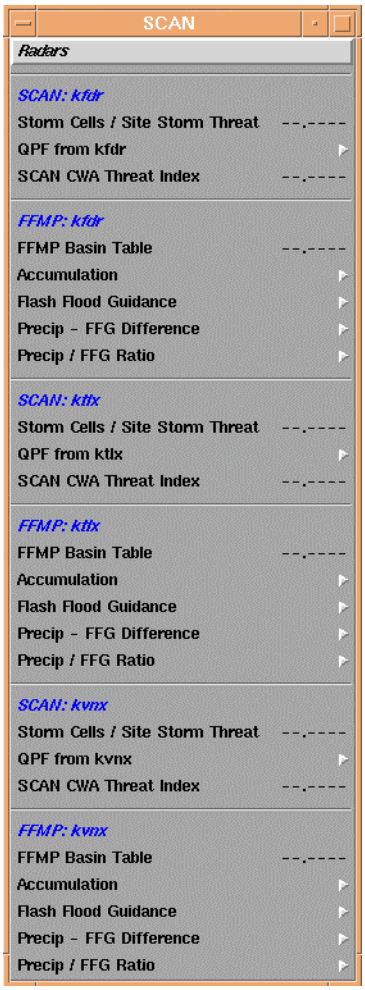
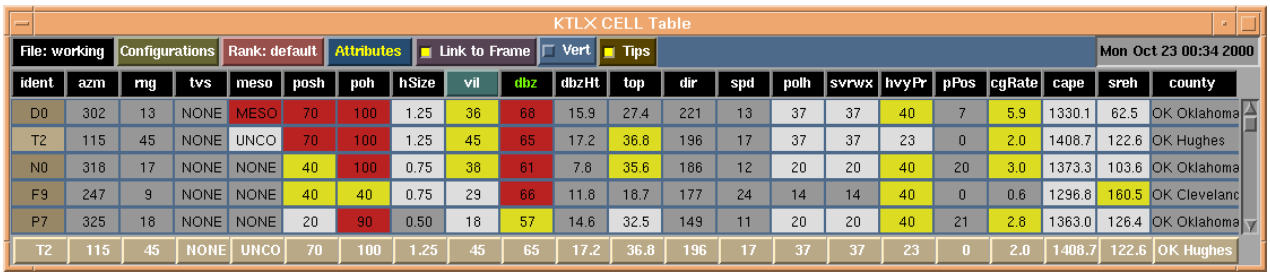


Figure 2. SCAN submenu.



ident	azm	rng	tvs	meso	posh	poh	hSize	vil	dbz	dbzHt	top	dir	spd	polh	svrwx	hvyPr	pPos	cgRate	cape	sreh	county
D0	302	13	NONE	MESO	70	100	1.25	36	66	15.9	27.4	221	13	37	37	40	7	5.9	1330.1	62.5	OK Oklahoma
T2	115	45	NONE	UNCO	70	100	1.25	45	65	17.2	36.8	196	17	37	37	23	0	2.0	1408.7	122.6	OK Hughes
N0	318	17	NONE	NONE	40	100	0.75	38	61	7.8	35.6	186	12	20	20	40	20	3.0	1373.3	103.6	OK Oklahoma
F9	247	9	NONE	NONE	40	40	0.75	29	66	11.8	18.7	177	24	14	14	40	0	0.6	1296.8	160.5	OK Clevelanc
P7	325	18	NONE	NONE	20	90	0.50	18	57	14.6	32.5	149	11	20	20	40	21	2.8	1363.0	126.4	OK Oklahoma
T2	115	45	NONE	UNCO	70	100	1.25	45	65	17.2	36.8	196	17	37	37	23	0	2.0	1408.7	122.6	OK Hughes

Figure 3. SCAN Storm Cell Table.

SCAN Storm Cell Table Example

Menu/Information Bar	Located in the top row of the Storm Cell Table, this bar contains menus and buttons to control the information that SCAN displays.

The **File menu** contains options to retrieve and save Storm Cell Table configurations.

The **Configurations menu** includes choices to set up the D2D display, change alarm parameters, control the trend function, and control the color thresholds of storm cell attributes (box colors).

The **Rank menu** allows the user to choose the storm cell attribute by which the data in the table body will be sorted. For example, clicking on VIL in the Rank menu will cause all the cells to be ranked by their cell-based VIL values.

The **Attributes menu** allows the user the option to choose which of the available storm cell attributes will appear on the storm cell table.

The **Link to Frame** button is a toggle button that links the time in the cell table to the time of the scan storm cell display product in the D2D session.

The **Vert** button is a toggle button that allows for either a vertical or horizontal orientation of the storm cell table.

The **Tips** button is a toggle button to turn off or on the tips functionality. When on, and the mouse cursor is located over a “clickable” widget, a pop-up text window appears with useful information about that widget.

On the far right is the **Valid Time Box** indicating the UTC time for which the data in the storm cell table are valid.

On the occasion when a Rate-of-Change Alarm threshold has been surpassed, a **blinking alarm** button will appear to the left of the Valid Time Box. Right clicking on the alarm button will toggle the audible alarm while left clicking will bring up the Alarm Information Window.

Attribute Title Row

The next row down from the Menu/Information Bar is the Attribute Title Row. It is a row of labels for all attributes selected in the Attributes menu**. Left clicking** on a particular attribute label will cause the storm cells to be ranked by that attribute in the table body. A **right click** on a particular attribute label will bring up the **Attribute Color Threshold (ACT)** window (see figure 4 on page 9). Finally, right clicking on the MESO or TVS attribute label will launch the MESO and TVS SCAN table respectively.

The Table Body

This is a display of all the storm cell information including: the alphanumeric identifier, location (azimuth/range, lat/lon, or state/county), TVS/MESO algorithm detections, severe weather probabilities, and other storm characteristics. The lack of any identified cells will yield a message “NO CELL DETECTIONS” in place of the table. Each attribute for each storm cell has a **color coding scheme** (white, yellow, red) whose color thresholds are defined in the ACT window (see figure 4 on page 9). Cell attributes exhibiting values exceeding the highest threshold color will show as red table grid boxes. This is designed to help the user immediately spot the cells exhibiting high values of a particular attribute.

A time trend for a particular cell can be invoked for the cell attribute in question by **left clicking** on the table grid box containing the particular attribute for that cell. As an example, for cell ID T2, left

clicking on the VIL for T2 will invoke a time trend of VIL.

A trend set window can also be invoked by **right clicking** on the storm cell ID identifier box. The parameters to be shown in the trend set window can be determined by going into the Trend Set option within the Configurations menu in the Menu/Information bar.

A user can **zoom** into a particular storm cell on the D2D window by **left clicking** on the storm cell ID.

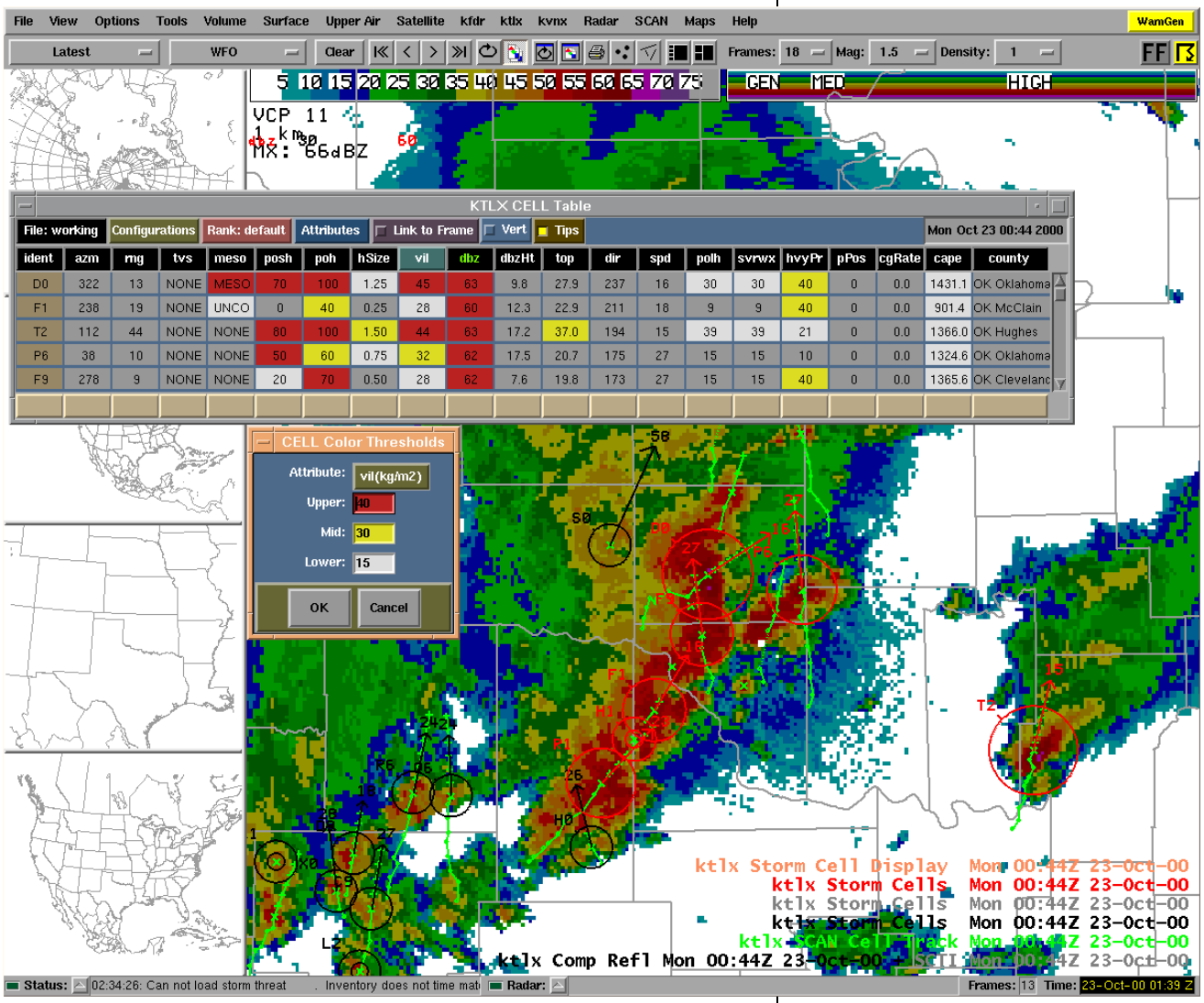


Figure 4. Attribute Color Threshold Window.

The Inspections Window

The act of **left clicking** on the storm cell ID in the cell table will **duplicate the attributes** for that cell from the table body down into the inspections row at the bottom of the storm cell ID table. This row emphasizes the data for the last storm that was inspected. The individual table grid boxes in this row have the same mouse cursor functionality as in the main table body. The one exception is that left clicking on the identifier box will zoom the D2D back out to the zoom level defined in the D2D menu bar.

The SCID Window

The Storm Cell Identification Display (SCID) window, launched from the Configurations menu, allows the user to control the zoom factor of the inspected cell and the appearance of the storm cells displayed on the D2D window. (See Fig. 5 on page 11.) Appearance of the symbols in D2D can be broken into **circles, motion vectors (arrows), and storm ID labels**. An operator can select whether or not to display everything except for the past/future tracks by toggling the buttons located under the “Symbols” label inside the SCID window. When arrows are displayed, the arrow length can be configured by a cell speed conversion factor. The **radii of the circles** around each plotted storm cell centroid on the D2D are set to be proportional to the value of a chosen attribute. Additionally, the **circles are assigned colors** (white, yellow, red) based upon threshold values of a particular cell attribute chosen in the Cell Identifier Clutter Control.

The SCAN CWA Threat Index (SCTI)

SCAN includes a GUI button display that affords the user a quick assessment of the general threat of severe weather over the County Warning Area (CWA). Two buttons are located below the WarnGen button on the D2D; the right one with the severe thunderstorm symbol indicates the maxi-

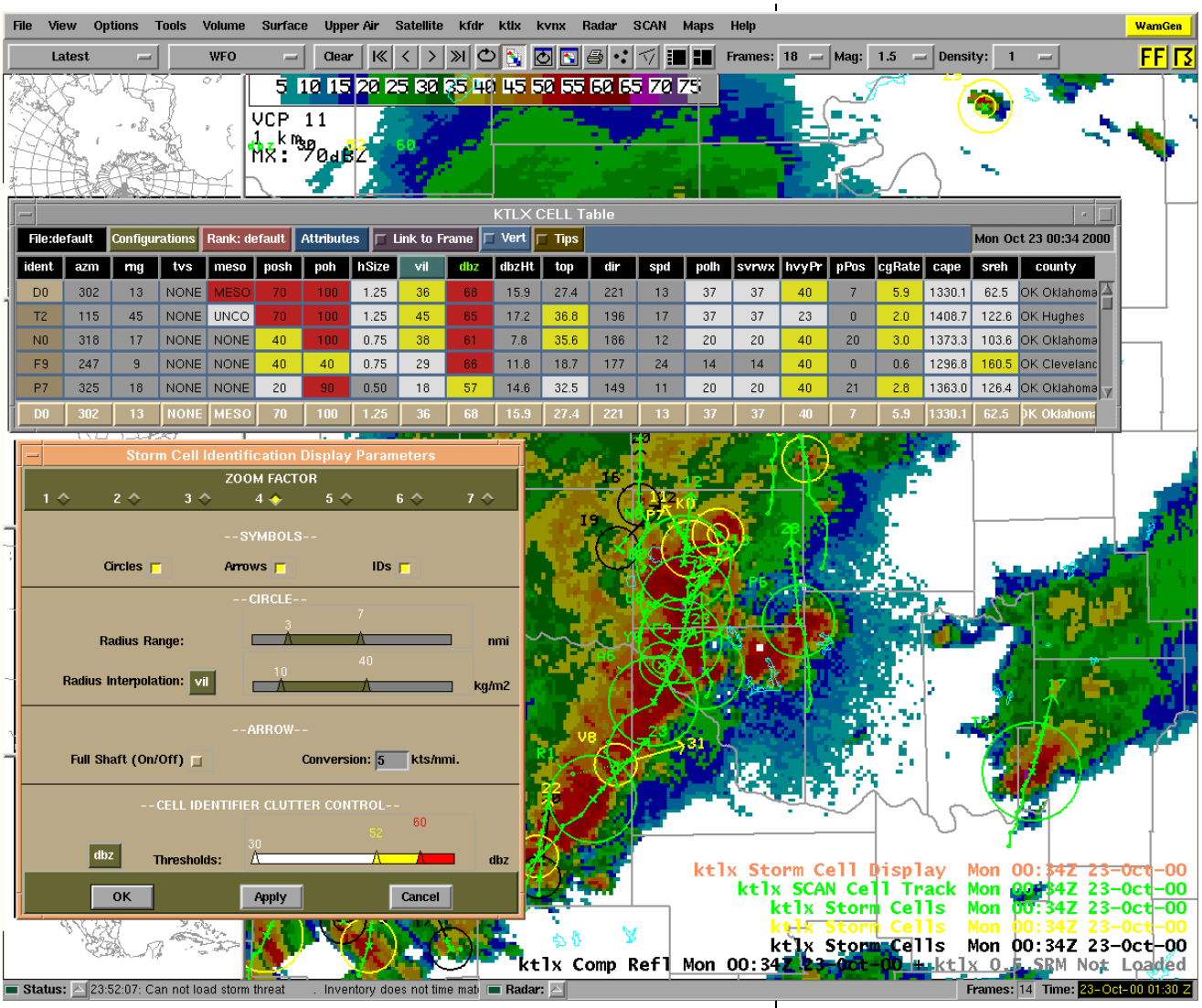


Figure 5. Storm Cell Identification Display (SCID) window.

mum value of the SCTI in the CWA. Placing the cursor over one of the two buttons will produce a small text tip widget with information on the maximum value of SCTI over the CWA.

The SCTI is created by searching for several thunderstorm parameters that fall closely to a radar-centric field of 4 X 4 km grid boxes. These include VIL, 4 km CZ, cloud-to-ground lightning (CG), presence of Meso and TVS detections and a Severe Weather Probability (SWP) based on VIL

and environmental proximity sounding information. For more information on the SWP, see:

`http://www.osf.noaa.gov/dlcourses/scan/swp/awipssvr.html`

These ingredients are combined into the SCTI whose values range from 10 to 100. For display purposes, the SCTI is color coded. Table 1, shows the relationship between the SCTI values, the input ingredients and the color coding. If the SCTI button is **grey** then SCAN is not running.

The SCTI product can also be displayed as a 4 km **radar-centric gridded product** selectable from the SCAN section of the D2D menu. The gridded SCTI has the same color scheme as that of the buttons described above.

Table 1: SCTI Values

SCTI = 100	Cell SWP ≥ 70, MESO and TVS	**red**
SCTI = 90	Cell SWP ≥ 70, MESO or TVS	**red**
SCTI = 80	Cell SWP ≥ 70	**red**
SCTI = 70	30 ≤ Cell SWP < 70, MESO and TVS	**yellow**
SCTI = 60	30 ≤ Cell SWP < 70, MESO or TVS	**yellow**
SCTI = 50	30 ≤ Cell SWP < 70	**yellow**
SCTI = 40	Cell SWP < 30, MESO and TVS	**yellow**
SCTI = 30	Cell SWP < 30, MESO or TVS	**yellow**
SCTI = 10	CG LTG, high VIL, high reflectivity	**green**
No activity		**white**

Storm Site Threat

The **Storm Site Threat** product informs the user of the level of threat imposed on a geographical site by proximity to storms. Displayed in D2D, geographical sites (e.g., towns) are identified as tiny squares under benign conditions.

Under threatening conditions, the squares enlarge and show the site name. The Storm Site Threat display is invoked along with the SCAN Cell Table and the storm cell graphical display in D2D. See Figure 6 on page 14 for an example of the site threat display in D2D.

Pressing the left mouse button (keep it pressed) and moving the cursor over the local sites allows popup information regarding the status of these sites to be displayed by the cursor. These include:

- Site name
- Threat at site; yes or no;
- If there is a threat, a reason for its existence
- Status of the SCAN processor (whether radar data, lightning data or both are available)

This product is designed to show threats commeasurate with aviation concerns. Therefore, both severe and nonsevere thunderstorms within 10 nautical miles of the site (typically airports) will increase the site threat values.

Trend Windows

Two trend windows (dBZHT and top) also display the trend of the altitude of each radar beam as it passes through the cell. The trends of the radar beam altitudes can then be compared to the height trends of the dBZHT and top parameters in order to help assess the accuracy of these parameters. For example, Fig. 7 on page 15 shows a trend of a storm top marked by a dark line with circles and the trends of all radar beams at the storm location marked by thick white lines. The user can then assess the vertical sampling resolution available to create the storm top trend (roughly 5000 ft in Figure 7).

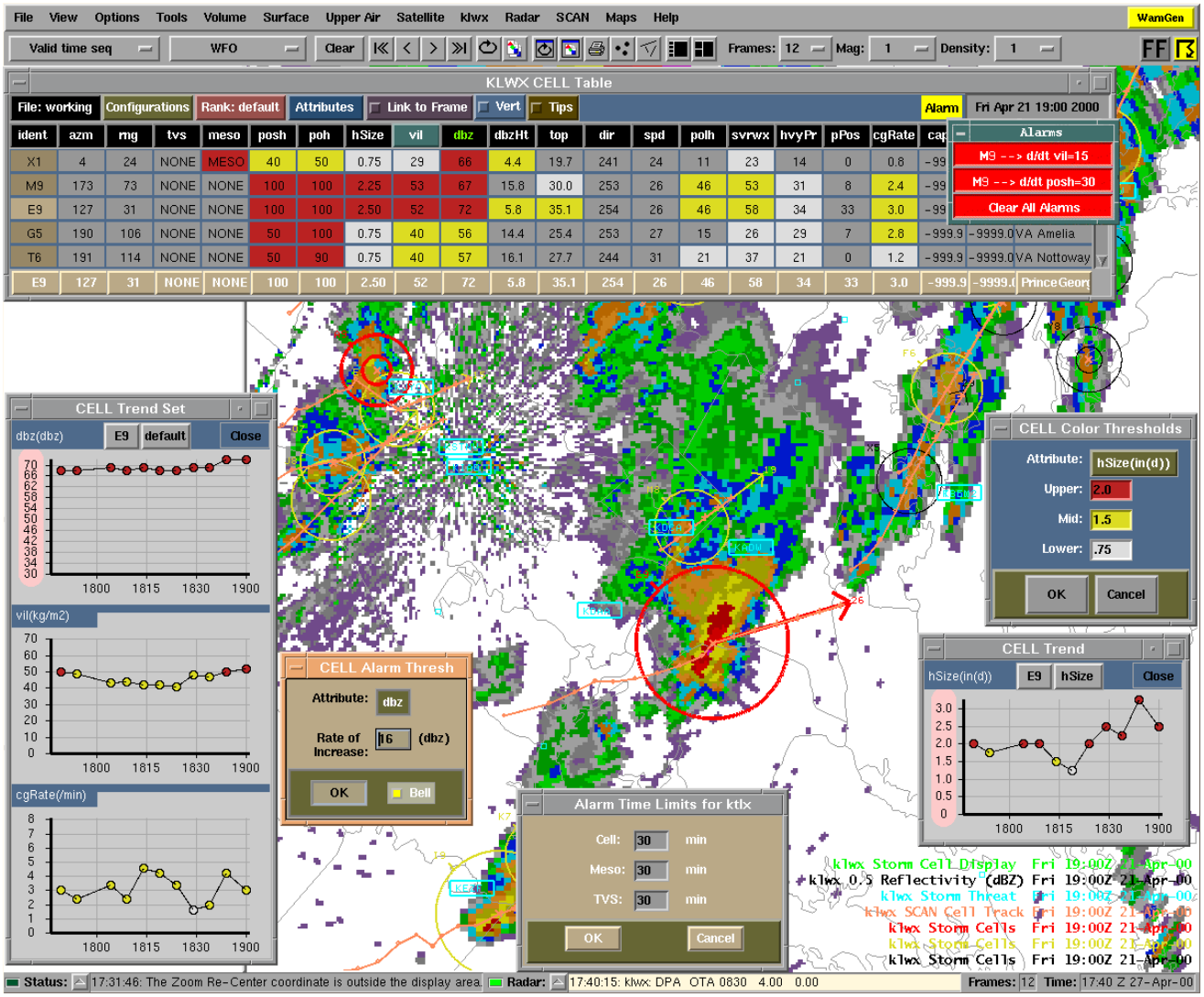


Figure 6. Rate of Change Alarm Threshold Window.

In addition to a single trend window, a group of two to five trends called a trend set can be displayed by two methods:

1. Right clicking on a storm-cell ID box in the Cell Table.
2. Right clicking on the cell centroid in the D2D window when the Storm Cell Display is made active or editable. Right clicking on the “Storm Cell Display” text label in the bottom right portion of the main D2D pane and selecting editable activates this functionality.

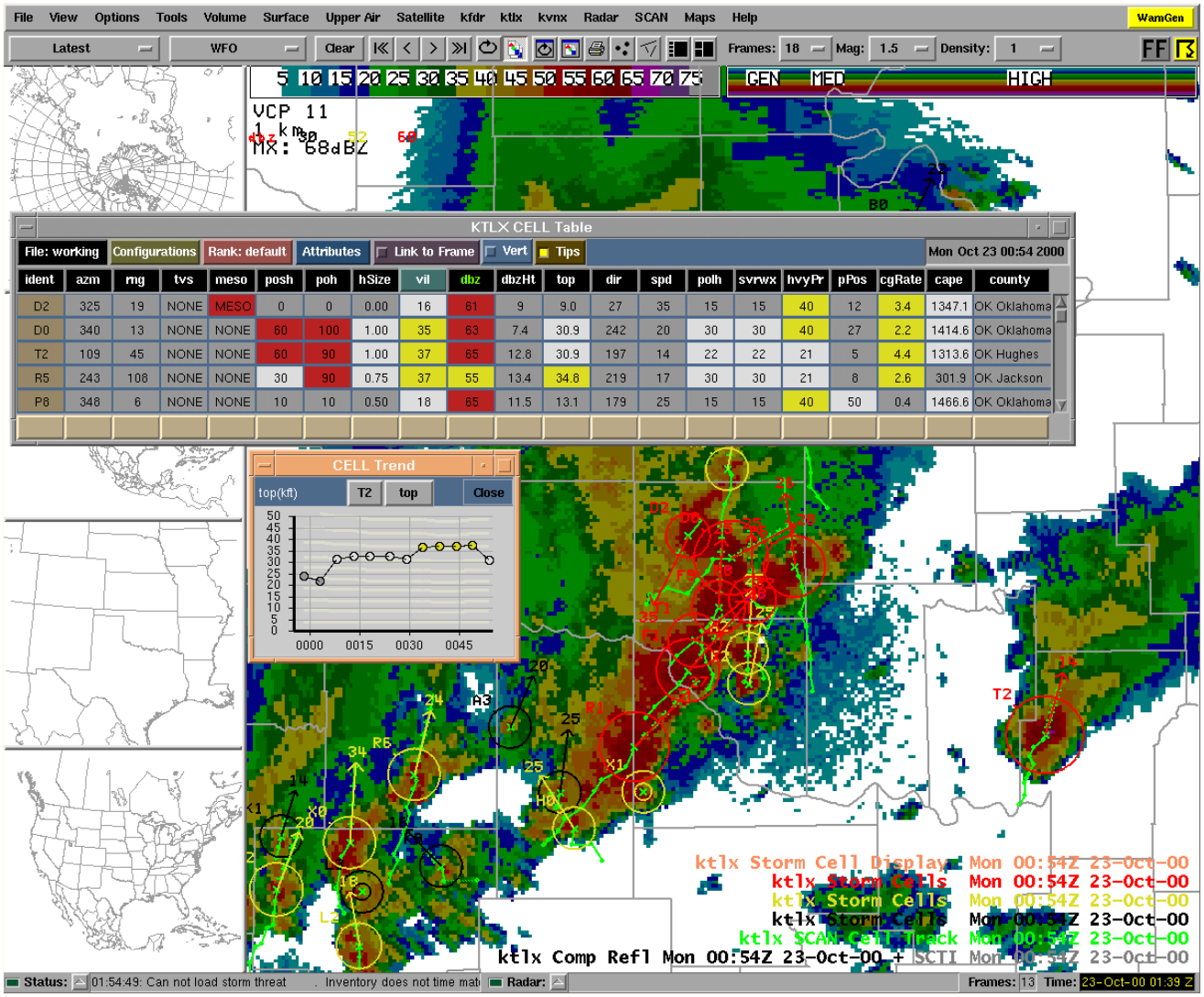


Figure 7. Single-Trend Window. Well sampled storm top trend with an overlay of the radar beam heights.

The parameters to be shown in the trend window can be chosen using the Trend Set selection within the Configurations menu in the cell table. A particular group of parameters for a trend set can also be saved with a trend set name, edited or deleted. Once the trend set window is displayed, the operator can use the Storm ID and Trend Set Name buttons on the top of the window to view trend sets for any identified cell.

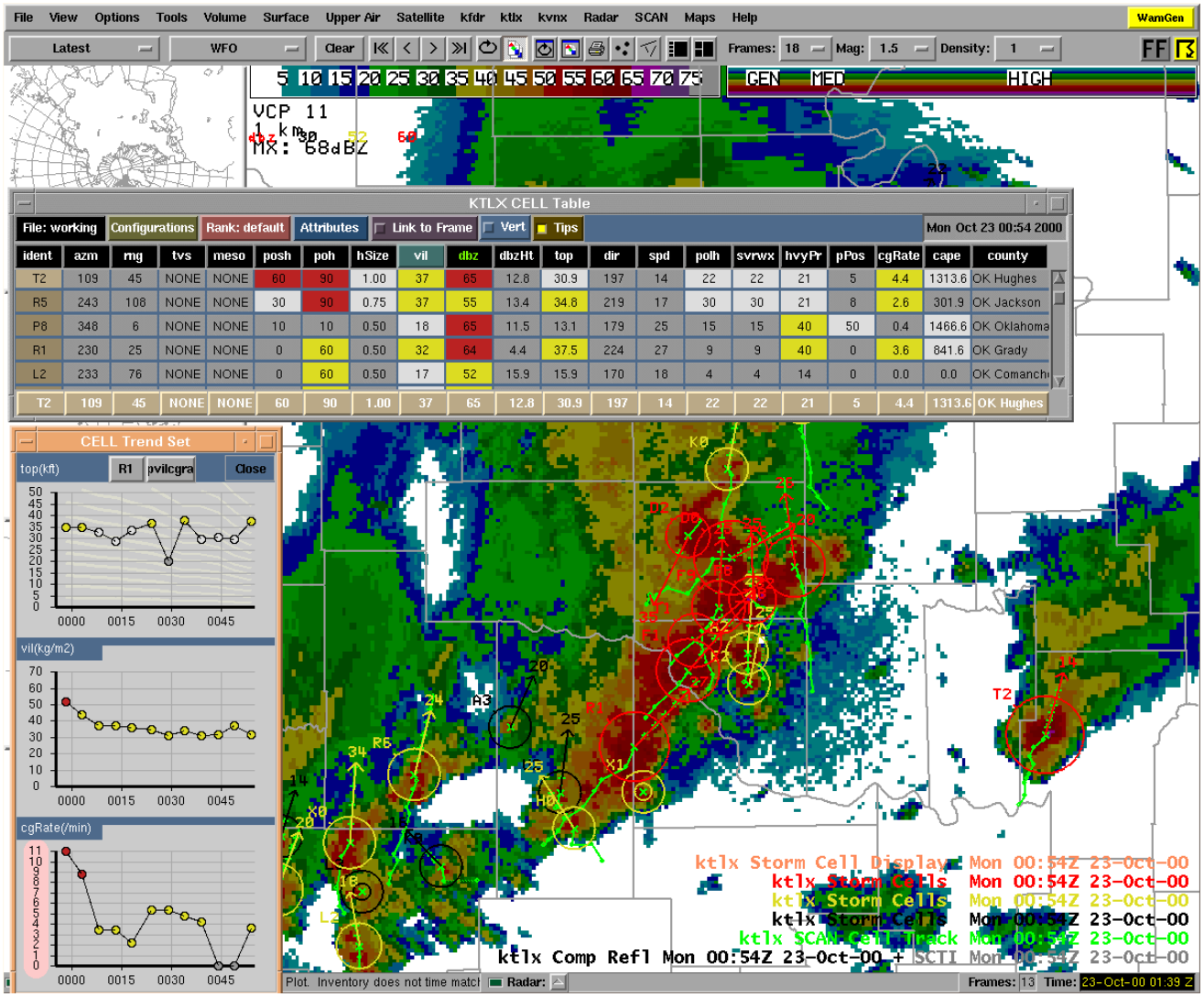


Figure 8. Multi-Trend Window. Example of a trend set with an incorrect storm top at 0030 UTC.

The Attribute Color Threshold Window (ACT)

The color coding of the small circles in the trend windows and that of the table grid cells are defined in the ACT window. A **right click** on a particular **attribute label** in the cell table will bring up the **ACT** window. (See Fig. 4 on page 9.) The ACT window allows the user to define ranges for any applicable storm cell attribute. These ranges reflect the degree of strength of the storm according to the chosen attribute, ranging from white (weak) to yellow (moderate) to red (strong). For the example in Figure 4, the chosen attribute is cell-based VIL, and the color ranges have been

picked to highlight all storms with at least 40 kg/m^2 as red, 30 – 39 kg/m^2 as yellow and 15 – 29 kg/m^2 as white.

Rate of Change Alarm Threshold Window

SCAN has an alarm function that can be used to alert an operator to significant increases in particular storm cell attributes between the last two complete volume scans. If a particular storm attribute exceeds the specified rate-of-change, an alarm button appears next to the time box in the cell table. An audible alarm sounds at the same time. Left clicking on the alarm button allows the user to view the alarm triggers and clear the alarms. By **left clicking** on an individual alarm cell, a trend for the alarmed cell and attribute will appear, the D2D display will zoom to the alarmed cell, and the inspection row in the SCID window will fill up with information on the alarmed cell. A user may clear all the alarms by left clicking on the **"Clear All Alarms"** button. See Figure 6 on page 14 for an example of an alarm information window.

An operator has the ability to modify the alarm settings. The **New Alarm Time Setup Window,** launched from the Configurations menu, allows the user to set time thresholds for determining when new SCAN alarms are issued. These new alarms are issued with new cell activity or when a Meso or a TVS is identified after a quiet period that is set by the user. The window name is labeled as Alarm Time Limits for KXXX (where KXXX is the radar ID). The **Rate-of-Change Alarm Threshold Window**, also launched from the Configurations menu, allows the user to set thresholds for the rate of increase of a particular attribute on which SCAN issues an alarm. The Rate-of-Change Alarm Threshold Window is labeled as the "Cell Alarm Thresh" window as shown in Figure 9.

Figure 9. Cell Alarm Threshold Windows.

SCAN Data Monitoring System (DMS)

The SCAN Data Monitoring System (DMS) is an automated system for monitoring the status of SCAN components. The SCAN DMS can be accessed in AWIPS through a browser that supports frames by loading http://as1f/infoPages/SCAN_DMS.html.

SCAN DMS Display

The SCAN DMS Display is divided into two frames in your browser (see Fig. 10). There is a small static frame at the top of the page that holds title

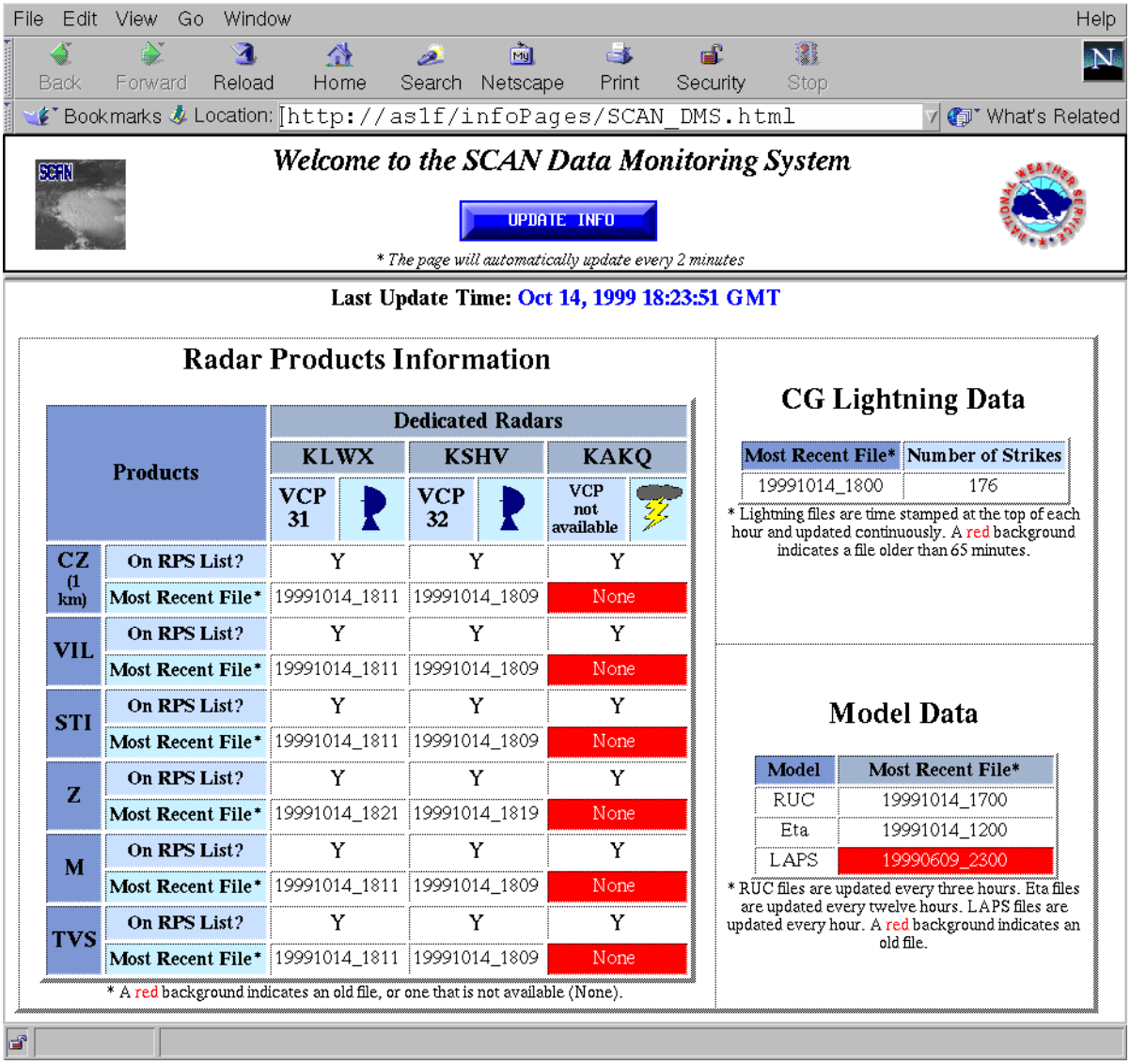


Figure 10. The SCAN DMS display.

information and a button for updating the table. The main frame holds the Radar Products Information Table, CG Lightning Data Table, and the Model Data Table. Each table displays information about the most recent file or whether the data are old or doesn't exist (red colored table cells) on the system.

SCAN in Warning Decision Making

Because SCAN heavily utilizes radar algorithm output, all the caveats of using radar algorithm output in warning decision making apply to their use in SCAN. An aggressive investigation of the most recent base data by an experienced radar operator will allow for the most timely and accurate warning decisions due to limitations in algorithm performance and the delay in creating algorithm output (5 + minutes in VCP 11 and 6 + minutes in VCP21). Therefore in situations where staffing affords detailed storm-by-storm analysis (e.g. sectorized warning operations), SCAN is best used as a "safety net" to alert the forecaster to severe storm attributes overlooked in the base-data analysis. As the number of storms increases relative to an office's ability to interrogate all storms, algorithm output, and hence, SCAN usage, is relied upon more in the warning decision making process. Prior to use in a warning environment, the warning forecaster should become comfortable with the default configuration settings and the mechanics of displaying storm attributes in SCAN.

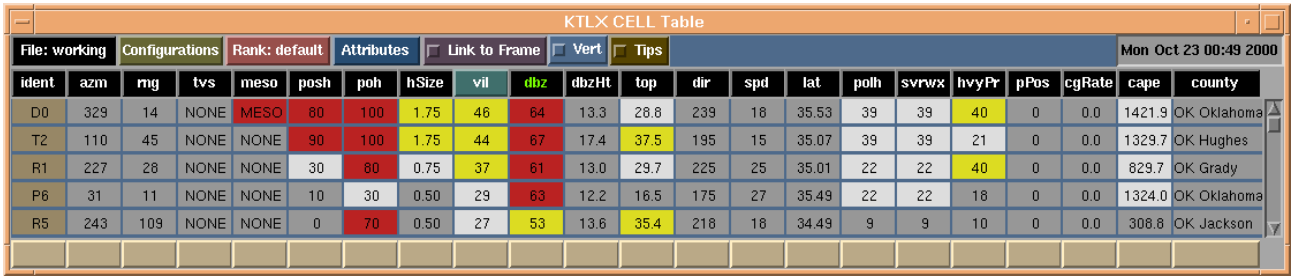
"Safety Net" D2D Configuration with SCAN

Efficient use of two D2D sessions is a key element in using AWIPS to make warning decisions. A common display workstation setup for warning operations is to have one D2D session configured for storm interrogation and another D2D session configured for mesoscale analysis. The following is one suggested way for configuring the workstation to incorporate SCAN. Of course, many other

configurations are possible. A single pane in the storm interrogation D2D session is an appropriate location to load SCAN. An example of SCAN integrated into a D2D warning setup is shown in Figures 11 and 12. In the 5-panel storm interrogation D2D session, the small pane #1 (in the far upper left) contains a Z/V product combination that is time matched to the graphical SCAN threat output (i.e. the SCAN threat output is loaded first, and the Z/V product is loaded second). The SCAN cell table output (see Fig. 11) is related to the SCAN threat output located in this pane. This pane is used to relate the SCAN output to low-level storm structure. At this time wind damage was a threat with the developing bow echo, so Z/V was being used rather than Z/SRM.

The small pane #2 contains AWIPS tables (TVS, Meso, and Hail Index) available from the radar pull-down menu that are time-matched to a CZ/VIL product combination. The data in this pane are used to obtain a partial understanding of changes in storm organization and as a first look at the graphical output of the radar algorithms.

The individual algorithm output tables are utilized because they are usually displayed at least a minute sooner than the SCAN output and because they are the only way to display algorithm graphical icons. The small pane #3 contains a 4-panel



ident	azm	rng	tvs	meso	posh	poh	hSize	vil	dbz	dbzHt	top	dir	spd	lat	polh	svrwx	hvyPr	pPos	cgRate	cape	county
D0	329	14	NONE	MESO	80	100	1.75	46	64	13.3	28.8	239	18	35.53	39	39	40	0	0.0	1421.9	OK Oklahoma
T2	110	45	NONE	NONE	90	100	1.75	44	67	17.4	37.5	195	15	35.07	39	39	21	0	0.0	1329.7	OK Hughes
R1	227	28	NONE	NONE	30	80	0.75	37	61	13.0	29.7	225	25	35.01	22	22	40	0	0.0	829.7	OK Grady
P6	31	11	NONE	NONE	10	30	0.50	29	63	12.2	16.5	175	27	35.49	22	22	18	0	0.0	1324.0	OK Oklahoma
R5	243	109	NONE	NONE	0	70	0.50	27	53	13.6	35.4	218	18	34.49	9	9	10	0	0.0	308.8	OK Jackson

Figure 11. SCAN Table Cell Output.

Z/V product combination from the primary radar that is used for analysis of three dimensional storm structure. The small pane #4 contains an OHP product from the primary radar that is used to evaluate the flash flooding threat with these storms (Prior to the development of heavy precipitation amounts, the pane had been occupied by Z/V product combination from a second radar in the warning area that was used to obtain a different perspective of a storm being interrogated by the primary radar). The large pane contains a Z/SRM product combination from the primary radar that is used to evaluate rotational characteristics.

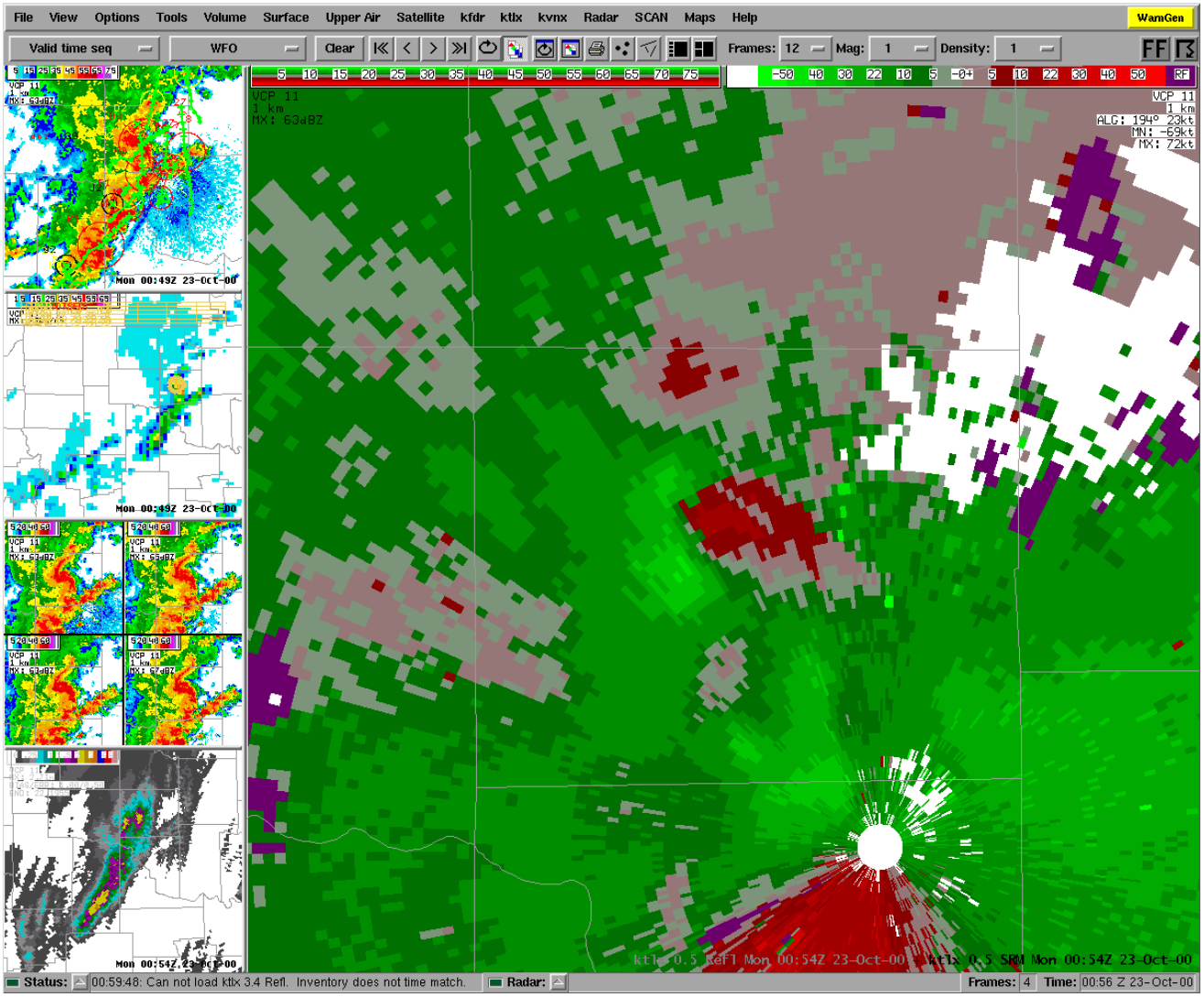


Figure 12. Storm interrogation D2D session including the SCAN threat output (upper left pane).

SCAN Use in Warning Decision Making - Helpful Hints

- Load SCAN first in an empty pane, and then load a radar product (e.g. Z/SRM). This will prevent the SCAN threat output from disappearing when the radar product updates, and it aides in keeping track of the SCAN D2D pane.
- Do not enable the **"link to frame"** option in the SCAN cell table unless there is a strong need to analyze table information (e.g. ranking changes) at a previous time. Redrawing the table for previous frames as the user steps through a frame sequence is a significant cpu load for the display workstation. Storm attribute data from previous times are usually best accessed using the trends options.
- Regularly compare the algorithm time in the SCAN cell table (see Fig. 11) to the current time displayed on the bottom right of the D2D window to know how old the algorithm output is. The algorithm output can be more than 10-12 minutes old depending on the VCP and the amount/size of products on the RPS list. (e.g. In VCP 11 the 2300 UTC volume scan algorithm data are updated with the 2305 UTC volume scan data at 2310 UTC.)
- Load SCAN output from the radar with the best sampling for the storms being interrogated. If SCAN output from multiple radars is desired, make sure that all the necessary products are on the RPS list. Take care not to overwhelm the display workstation with SCAN cell tables from too many radars.
- To obtain the fastest receipt of algorithm data in the D2D session, load the individual algorithm tables/graphics (TVS, Meso, and Hail Index) from the radar pull-down menus in a separate pane from the SCAN window. Display of the first algorithm output in SCAN can be delayed at least a minute after the individual algorithm tables/graphics.

- If SCAN's affect on workstation performance is a concern, run a "top" session (by typing "top" at the command line prompt in an external shell window) on the monitor containing the mesoscale analysis D2D session. The SCAN process that runs on the display workstation is called *"stormCellDispWish"*. If workstation performance is severely hampered make sure the **link to frame** option is not enabled.
- Remember the limitations of the algorithms when interpreting SCAN output. Trend data in particular can be misleading due to radar sampling limitations and algorithm performance.

SCAN Use in WDM Example

For this example the storm interrogation D2D session was created consistent with the "safety net" configuration discussed above. Note that care was taken to load SCAN in an empty pane followed by a combination Z/V product. In this situation, the primary area of severe weather threat is located along a line of storms close to the KTLX primary radar in the center of the CWA. Because attention has been focused on the most active threat area in the center of the CWA, the SCAN cell table update (see Fig. 11) yields a highly ranked storm with severe characteristics (cell T2 with 1.75 inch MEHS from the Hail algorithm and max reflectivity of 67 dBZ) that has been missed or overlooked by the hypothetical warning forecaster (note that because all panes in Figure 12 on page 22 have been zoomed in on the most active area, the base data and graphical algorithm output from the conventional algorithm radar tables did not alert the forecaster prior to the SCAN cell table). A check of the algorithm time in the SCAN cell table and the current time shows that the new SCAN cell table output is 7 minutes old.

Upon obtaining information from the SCAN cell table, the forecaster swaps the current pane with the small pane containing the SCAN threat output. After the SCAN pane is swapped to the main pane, a left-mouse click on the storm ID in the SCAN cell table results in a zoom centered on the cell's algorithm identified centroid (see Fig. 13). The Z/V data that is time matched to the SCAN threat output is used to quickly determine that the cell displays only weak rotation in low levels and

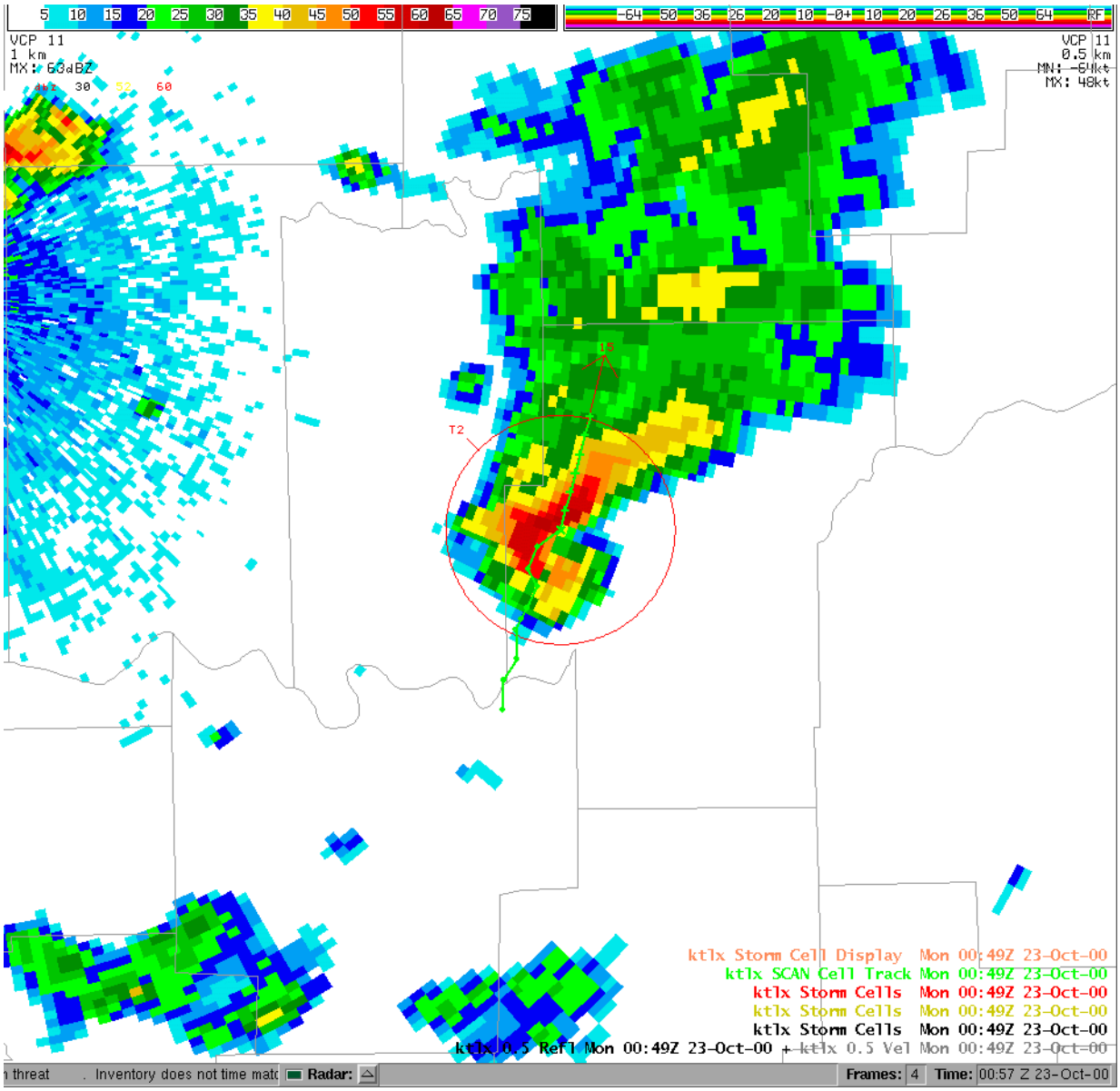


Figure 13. SCAN threat output displayed with 0.5° reflectivity data.

that the echo pattern looks like a maturing cell. A loop of the data also reveals that the hook echo-like geometry is a result of cell merger, and it is not a classic hook echo. Thus, the 7 minute-old base data was used to begin to validate the threat indicated by the algorithms, but further analysis is necessary to validate the threat suggested by the Hail algorithm. This information also warrants further investigation of the radar data before making the final decision to warn or not to warn.

Given that the 7-minute old lowest tilt Z/V data from the previous volume scan does not strongly suggest a severe storm, the forecaster follows up the preliminary analysis by examining three-dimensional storm structure in the four-panel Z/V product (see Fig. 14). A three dimensional analysis of the base data from the previous volume scan reveals a deep column of 60 dBZ reflectivity with 65 dBZ reflectivity from 13,000 -18,000 ft Above Radar Level (ARL). The maximum reflectivity existed above a strong low-level reflectivity gradient, suggestive of a strong updraft. The base data confirms the algorithm's suggestion that this storm contains large hail at this time. The most recent four-panel Z/V product is then analyzed to determine that the storm still contains a likely threat of large hail. Once the decision to warn has been made, WarnGen (which is located in the mesoscale analysis D2D session) is used to issue a severe thunderstorm warning with an emphasis on the large hail threat for the storm that was overlooked in the original base data analysis.

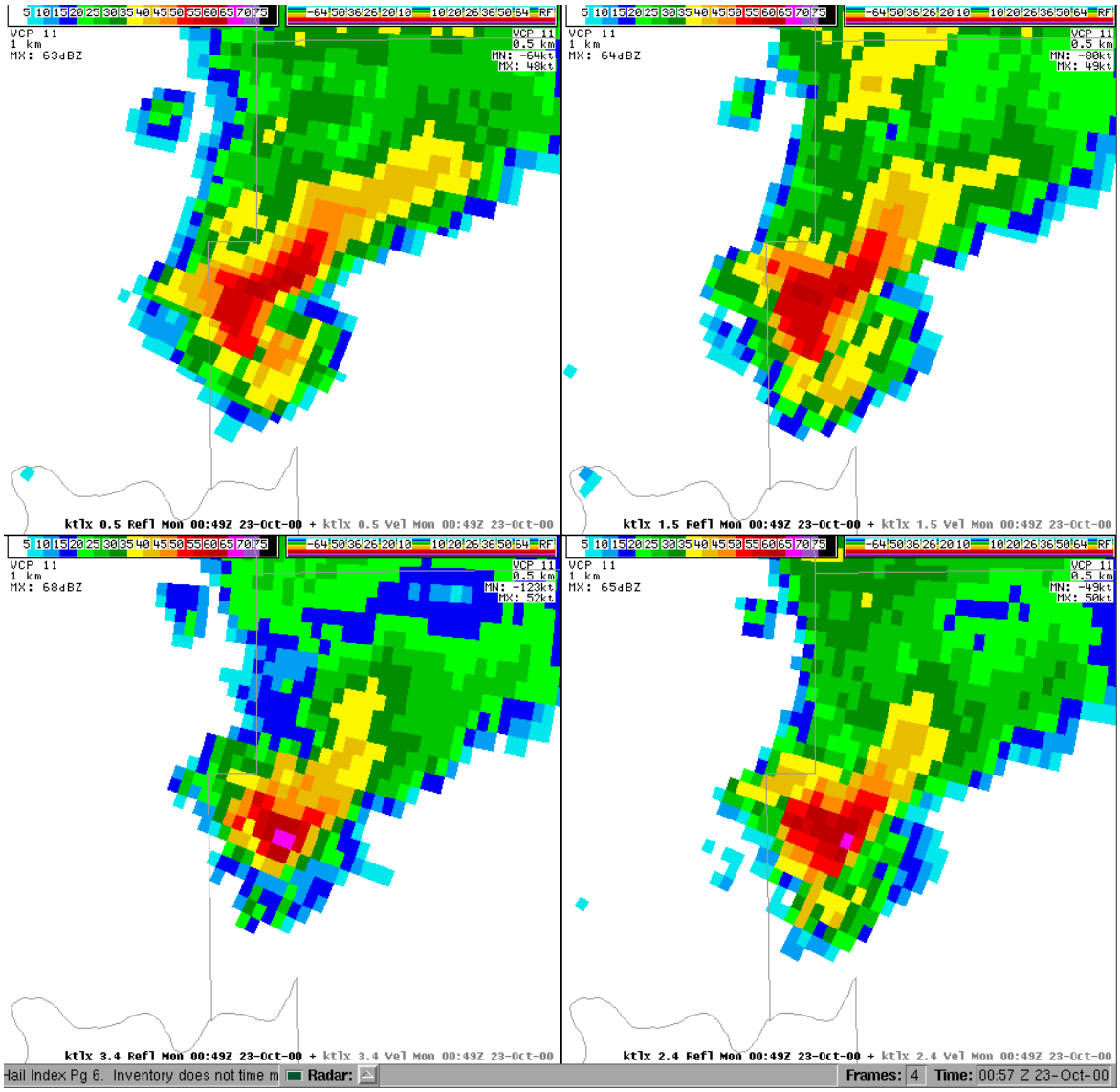


Figure 14. Four-panel Reflectivity Product.

Flash Flood Monitoring and Prediction (FFMP)

Flash Flood Monitoring and Prediction (FFMP) is a component of SCAN designed to aid the forecaster in identifying the potential for flash flooding during an event. The FFMP products and tables are accessed from the SCAN submenu. On this submenu, there are FFMP selections available for each dedicated radar. See Fig. 15.

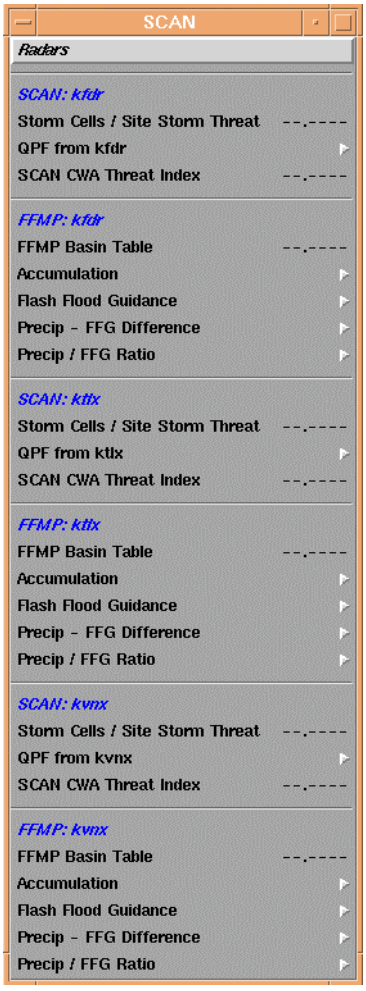


Figure 15. SCAN submenu.

Input Into FFMP

To identify potential flash flooding, the FFMP compares radar-estimated rainfall to flash flood guidance. This analysis is done in two formats: by county and by drainage basin.

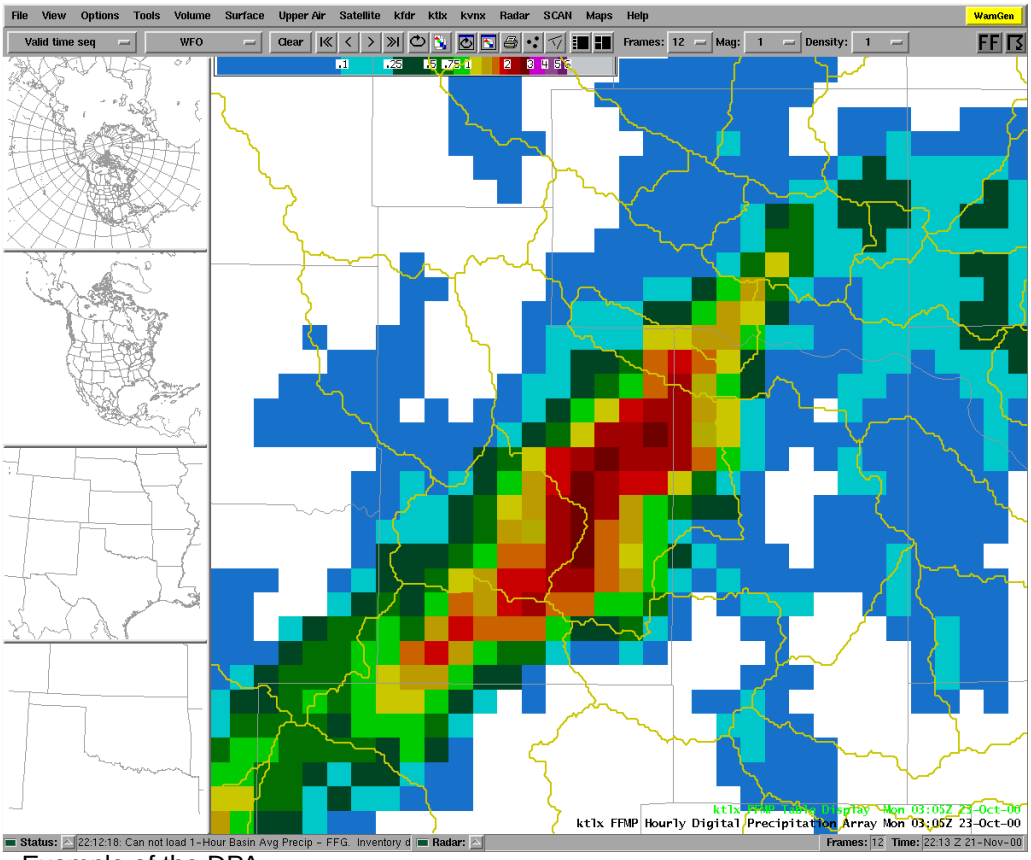


Figure 16. Example of the DPA.

Radar-Estimated Rainfall

The product that FFMP currently uses for rainfall input is the Digital Precipitation Array (DPA). The DPA is a one hour rainfall product that is updated each volume scan. This product is used to generate 1-hour, 3-hour, and 6-hour estimates of rainfall. The DPA is in a 2.2 nm (4 km) rectangular grid format, with 256 data levels. The DPA can be displayed from the Accumulation pull-down menu under the SCAN submenu. See Figure 16 for an example of the DPA.

Flash Flood Guidance

Flash Flood Guidance (FFG) for 1-hour, 3-hour, and 6-hour increments is also input into the FFMP. The FFG can be displayed for drainage basins or for counties, from the SCAN submenu. See Figure 17 for an example of FFG displayed by county.

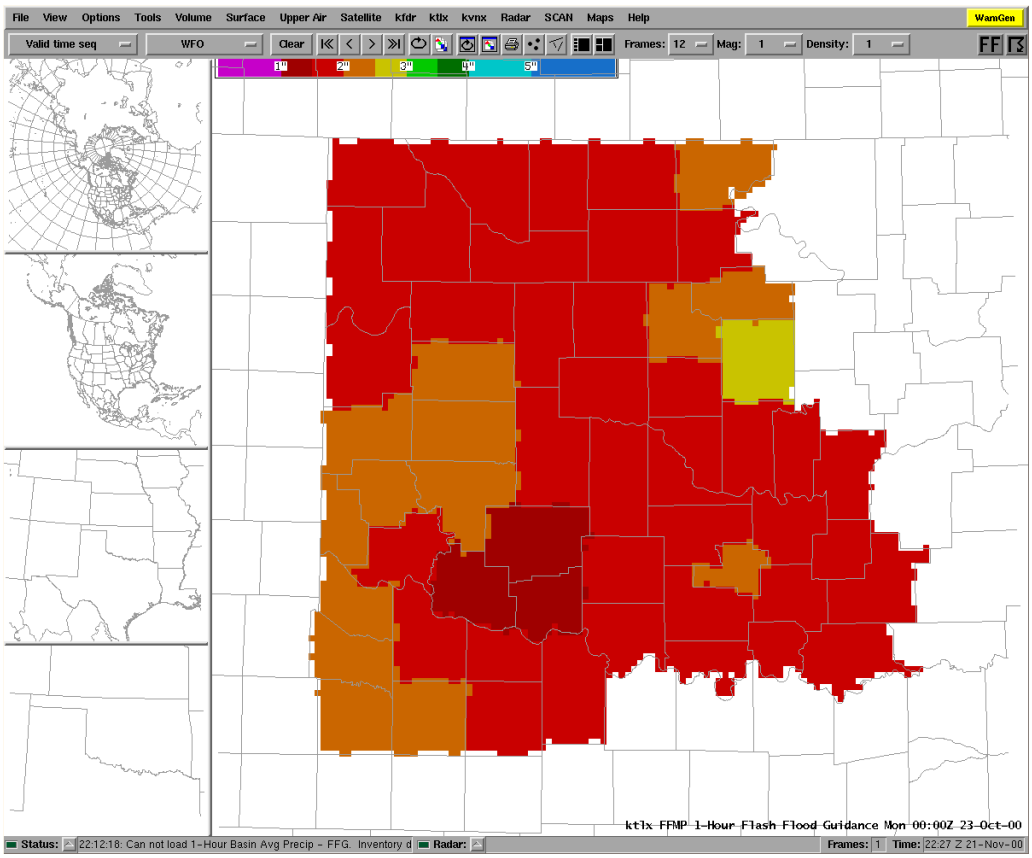


Figure 17. Example of Flash Flood Guidance graphic displayed by county.

FFMP Basin Table

The FFMP Basin Table summarizes the FFMP output and allows the operator flexibility over the display. It is loaded from the SCAN submenu and is available for each dedicated radar. It is ***strongly recommended*** that a product (OHP, DPA, etc.) be displayed ***before*** the Basin Table is loaded. This step allows D2D to time match and update products for the FFMP. See Figure 18 for an example of the FFMP Basin Table.

Menu/Information Bar

The top row of the table consists of buttons that access menus (File and Attribute) that control the display in the body of the table. Also provided is information regarding linking the table to the D2D image and the valid time of the table.

Area_Id	Precip	MaxPrecip	FFG	Precip/FFG	Precip-FFG
CCKO2	1.01	2.79	1.52	67	-0.51
ANDO2	1.05	2.28	1.50	70	-0.45
PRCO2	0.24	2.09	1.67	14	-1.43
RNDO2	0.39	2.03	1.35	29	-0.96
WLTO2	0.43	2.03	1.36	31	-0.93
WTYO2	0.51	1.81	2.46	21	-1.95
BKBTB	0.13	1.61	1.90	7	-1.77
SWNO2	0.80	1.52	1.75	46	-0.95
UNIO2	0.30	1.40	1.68	18	-1.38
BKBT2	0.17	1.36	1.53	11	-1.35

Figure 18. FFMP Basin Table.

The File menu allows for a number of options when manipulating basin configuration files, as well as the option to close the table. In later builds, flash flood monitoring on small sub-basins will be implemented, hence the need for differing basin configuration files.

File Menu

The Attributes menu allows the operator to control which attributes are displayed within the body of the table. The attribute choices are:

1. Precip: Average rainfall for the geographic area (basin or county)
2. MaxPrecip: Maximum rainfall grid value for the geographic area (basin or county)
3. FFG: Flash flood guidance
4. Precip/FFG: The ratio of the Precip to the FFG
5. Precip-FFG: The difference of the Precip and the FFG

Attributes Menu

This toggle allows the operator to choose whether or not the valid time in the FFMP Basin Table must

Link to Frame

match the time of the frame of a D2D image (OHP, DPA, etc.). If link to frame is activated, whenever the frame of a D2D image is changed, the Basin Table will update to match the new time. This will impact CPU usage, and must be used carefully.

Valid Time

This displays the UTC time for which the data in the Basin Table are valid.

Options Buttons

The second row of the table consists of buttons that control the type of data displayed in the table body.

Areas

The Areas button allows the operator the option of displaying the attributes by basin or by county. The basin name is the hydrologic forecast point for that basin, while the county name is the state/number combination used for each county in the zone forecast.

Sources

The Sources button identifies the data source for the FFMP computations displayed in the table. Currently, the source is the DPA, which is used to generate rainfall estimates of 1-hour, 3-hour and 6-hours ending at the current time. In future builds rainfall estimates may be based on the Digital Hybrid Reflectivity (DHR), which would provide the estimates at a higher resolution. Also in future builds, QPFs will be generated based on the rainfall estimates. Using this button, the operator may choose a QPF as the source, resulting in the attribute values in the table being based on future projections of rainfall.

Durations

The basin table values can be displayed for 1, 3 or 6 hour intervals. The durations button allows the operator to choose which interval will be displayed.

Attribute Title Row

This row provides titles for each of the columns in the body of the table.

Ranking by Attribute

From this row, the operator can change the ranking of the elements in the body of the table. The ranking is determined by the selection (left click of the mouse) of one of the attribute titles, which will then become purple in color. All the remaining titles will remain black.

Changing the Attribute Color Thresholds

For all of the attributes except the area name, thresholds can be set for the display color of the attribute. The selection is made by right clicking on the title of a particular attribute, which brings up a window for defining the thresholds. The colors green, yellow and red can be used to progressively display the threat.

Table Body

In the body of the table, the attribute values for each identified basin (or county) are listed. For example, basin CCKO2 has the following attributes:

1. Precip: Basin-averaged rainfall is 1.01 inches
2. MaxPrecip: Maximum rainfall is 2.79 inches
3. FFG: Flash flood guidance is 1.53 inches
4. Precip/FFG: The ratio of basin average rainfall to the FFG is 67%
5. Precip-FFG: The difference of the basin average rainfall and the FFG -0.51 inches

Inspection Row

The last row in the table is a duplication of the row in the table that was last inspected. Inspection is defined as selecting the basin (or county) name with the left mouse button, which results in a zoom and recenter at the relevant location on the product in the D2D large pane. See Fig. 19.

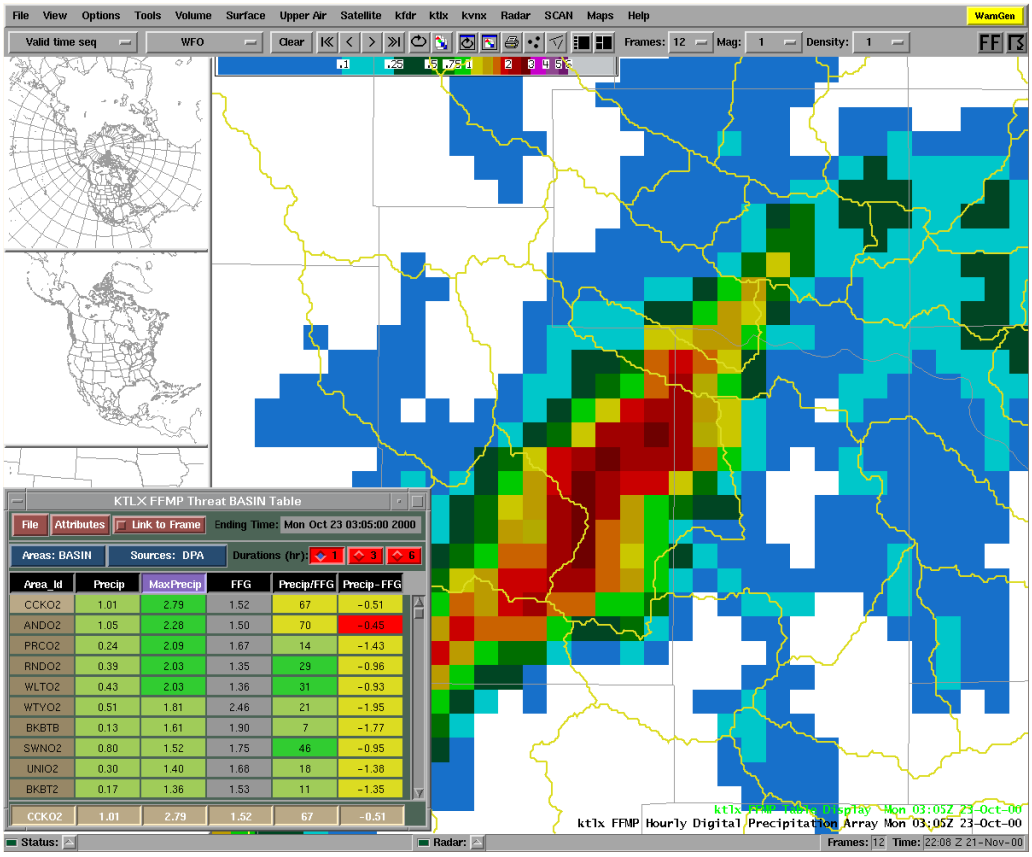


Figure 19. FFMP Basin Table with CCKO2 selected. Note the associated DPA has zoomed and recentered on this basin.

Assessing the Threat

In Figure 19, there are two basins with rainfall that were approaching FFG for the one hour period, CCKO2 (the Washita River at Chickasha, OK) and ANDO2 (the Washita River at Anadarko, OK). The inspection row is currently set at CCKO2, so the associated DPA product is zoomed and centered on the CCKO2 basin.

For CCKO2, the basin average rainfall has reached 67% of the FFG with 0.51 inches of rain yet to occur to reach FFG. For ANDO2, the basin average rainfall has reached 70% of the FFG with 0.45 inches of rain yet to occur to reach FFG.

Changing the Attribute Color Thresholds

Note the difference in color for the Precip-FFG amounts for the two basins. The operator can choose thresholds for the darker green, yellow and red for each of the attributes in the table. The

selection window, titled BASIN Button Colors, can be accessed by right clicking on any of the attribute titles. In this case, for Precip-FFG, the lower bound for red is -0.5. See Figure 20 for an example of the BASIN Button Colors selection window.

FFMP Flash Flood Threat Indicator

Under the WarnGen button on the D2D there is a indicator labeled “FF”. This is the FFMP Flash Flood Threat Indicator (FFTI). The color of the FFTI will represent the ratio of precipitation (DPA) to Flash Flood Guidance (FFG). If the FFG is unavailable or old, just DPA values will be used. The color code is displayed in Table 2, “FFTI Color Codes,” on page 36.

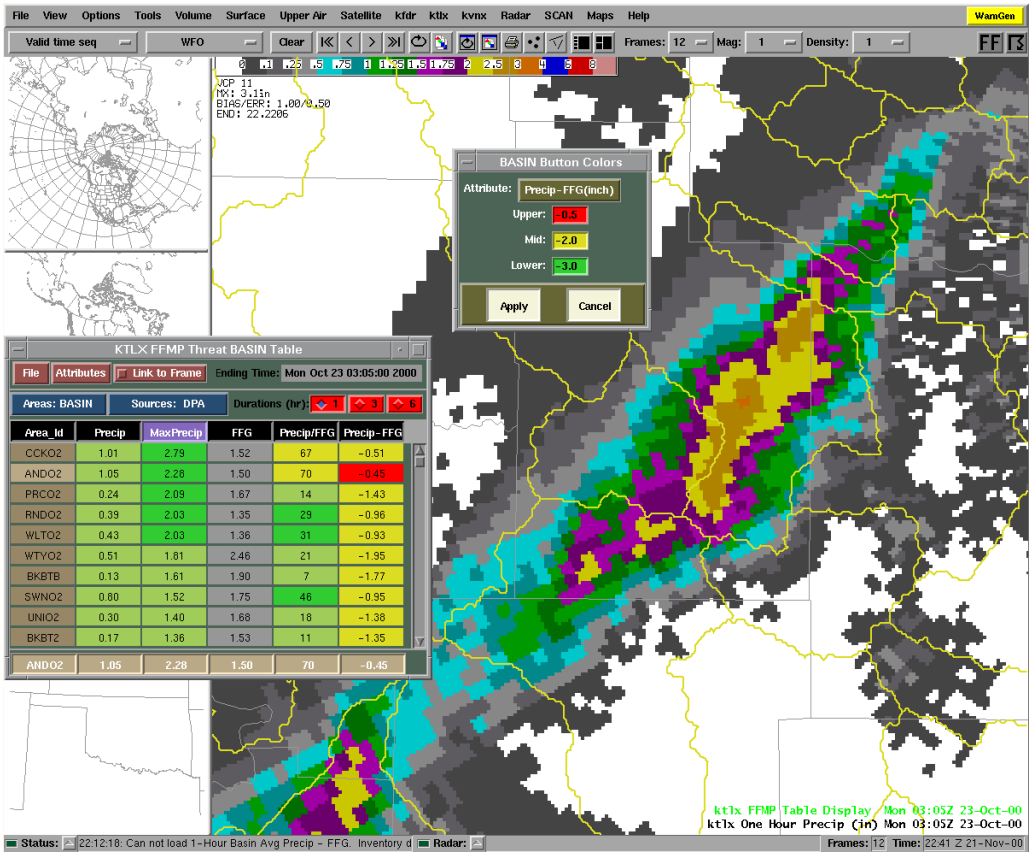


Figure 20. BASIN Button Colors selection window.

Table 2: FFTI Color Codes

White	indicates little or no activity in the CWA
Green	indicates precipitation in the CWA
Yellow	indicates precipitation estimates approaching FFG values in the CWA
Red	indicates precipitation estimates near FFG values in the CWA
Grey	indicates invalid index numbers, which means the FFMP processor is not functioning properly

FFMP Data Monitoring System (DMS)

The FFMP Data Monitoring System (DMS) is an automated system for monitoring the status of the components of FFMP. For example, the availability of the DPA is necessary for the computation of the rainfall elements, and the DMS identifies the status of the DPA availability. The DMS is web-based and can be accessed through any browser that supports frames. The URL is: http://as1f/infoPages/FFMP_DMS.html.

DMS Display

The DMS Display is divided into three parts, or frames in your browser. There is a small static frame at the top of the page that holds title information and the button for updating the table. The main frame holds the Radar Products Information Table and the Flash Flood Guidance Table. (See Figure 21).

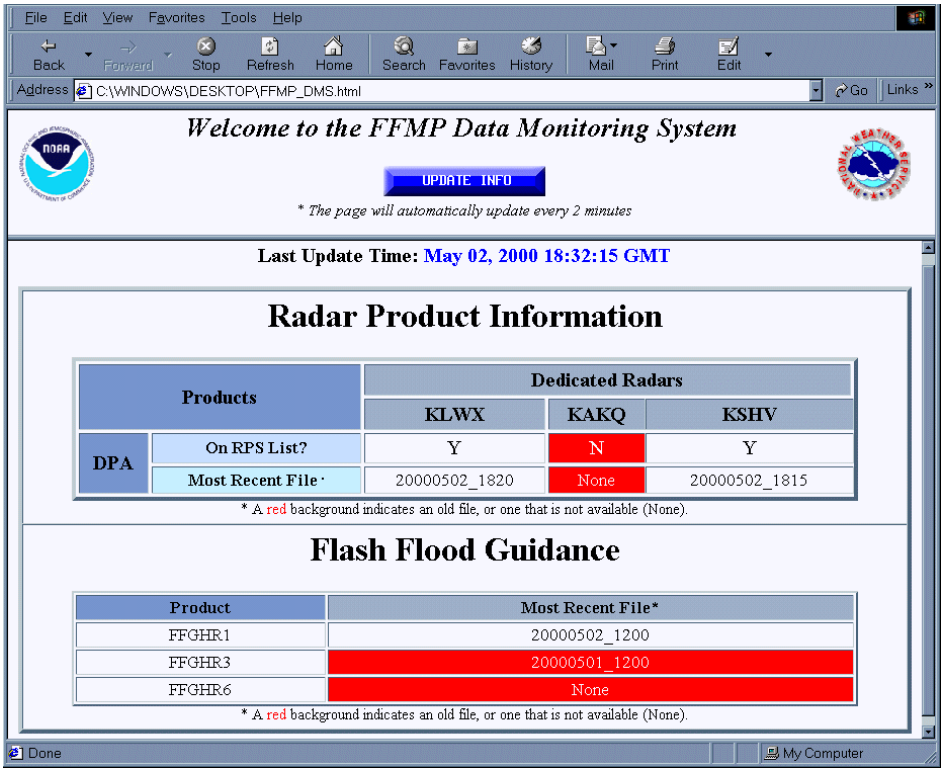


Figure 21. FFMP DMS Window.

DMS Radar Product Information Table

The Radar Product Information Table displays availability information on products relevant to FFMP. The DPA product is currently used by the FFMP for computing basin average rainfall and the maximum precipitation value. For each dedicated radar, the operator can determine if the DPA is on the RPS list, and the time and date of the most recent file. A red background indicates that the product is either old or unavailable.

Flash Flood Guidance

The Flash Flood Guidance (FFG) Table provides information on the availability of FFG for the time periods of 1-hour, 3-hours, and 6-hours. A red background indicates that the FFG is either old or unavailable.

Radar Enhancements

New Tools and Usability Features

AWIPS will now display an audible and visual alarm (red banner message) at the workstation when a site-specific forecast, watch, or warning product is received in "proximity" of a station's CWA. This proximity alarm feature will alert forecasters when, for example, a tornado warning has been issued by an adjacent WFO.

AWIPS will now display the same frame (time) when the user swaps panes from the large display pane to one of the smaller panes.

Polar Coordinates

The user can now display a polar grid centered at any geographical point independent of the associated radar's RDA location. See Fig. 22.

The cursor range readout now displays in nautical miles, and full product information is displayed in the upper left-hand corner of the product. (See Fig. 23.) This information includes VCP, product type, resolution(s) of products contained in the display, location of max value, and other parameter data which better defines the product (such as cross-section baselines, and AZRAN used in SRR or SWA products.)

The V_r Shear function is now displayed slightly differently on the large display pane. (See Fig. 24.) The output of the V_r Shear tool (from left to right) is rotational velocity, calculated as $(|Vin| + |Vout|)/2$ (displayed in units of knots), shear (displayed in units of s^{-1}), and the length of the line segment (displayed in nm) shown between the points selected for the V_r Shear computation.

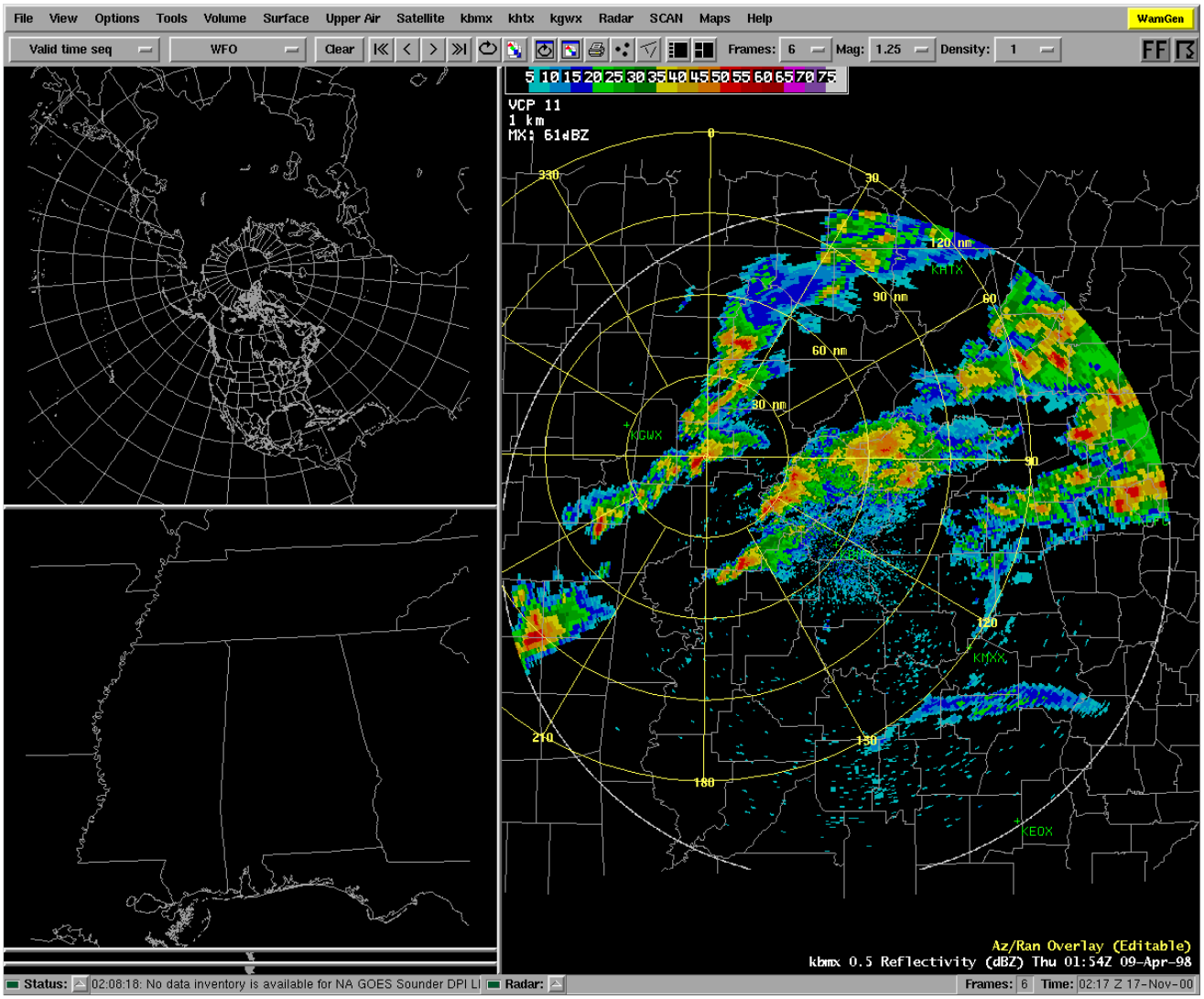


Figure 22. Polar Grid Overlay.

Other products that are correctly displayed in Build 5.0 are the Clutter Filter Control (CFC) and the User Selectable Precipitation. The CFC product now displays the elevation segment number and type of suppression (surveillance or Doppler) in the upper left-hand corner. The User Selectable Precipitation (User Def Total Precip on AWIPS) product now displays the time interval of rainfall accumulation.

In addition, the Combined Attribute Table (CAT) now automatically displays when the Composite

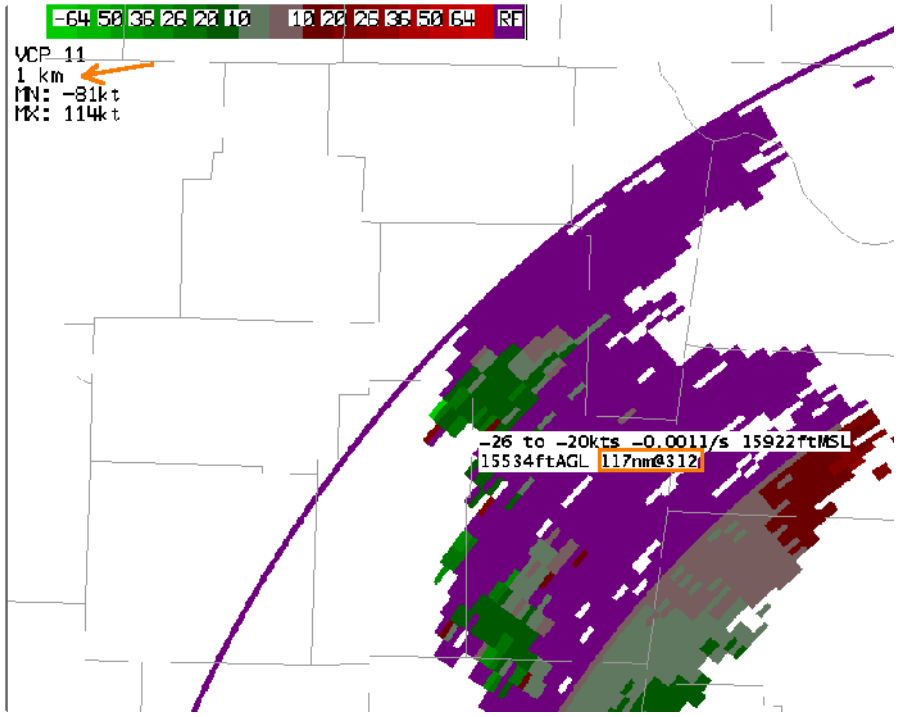


Figure 23. New product annotations and more complete product parameter information.

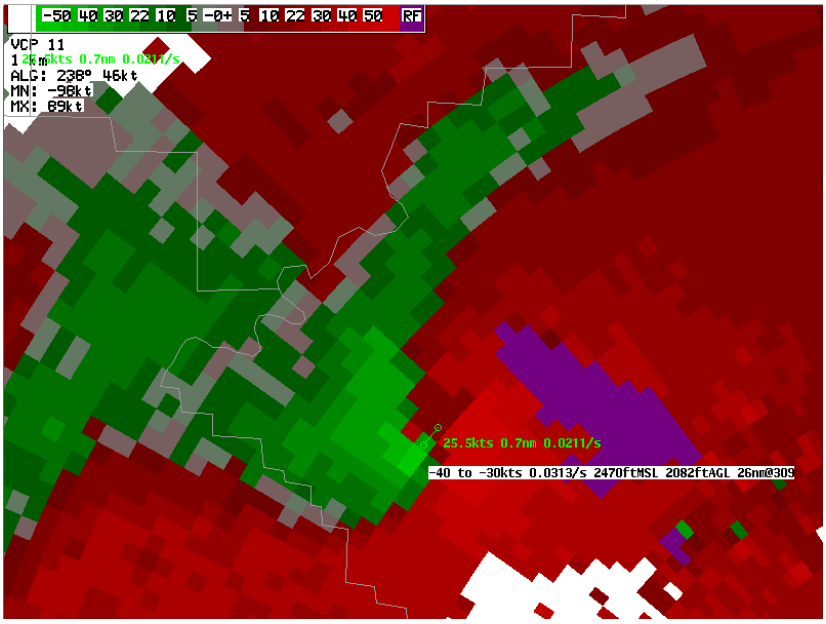


Figure 24. V_r Shear

Reflectivity (CZ) product (both 1 and 4 km) is selected. The CAT product is useful because it shows tabular output (up to 6 pages of 4 storms/page) from the TDA, Mesocyclone, HDA, and SCIT algorithms all on ***one*** table. (See Figure 25) In addition, the CAT allows viewing of the algo-

rithm output which is sent to the NIDS users. To view the CAT, look under the *kxxx Graphics* drop-down menu, select *Comb Att Table (1km CZ)* or *Comb Att Table (4 km CZ)*. (Note: with SCAN, tabular output from these algorithms is also viewable, but it takes slightly more time to process and display).

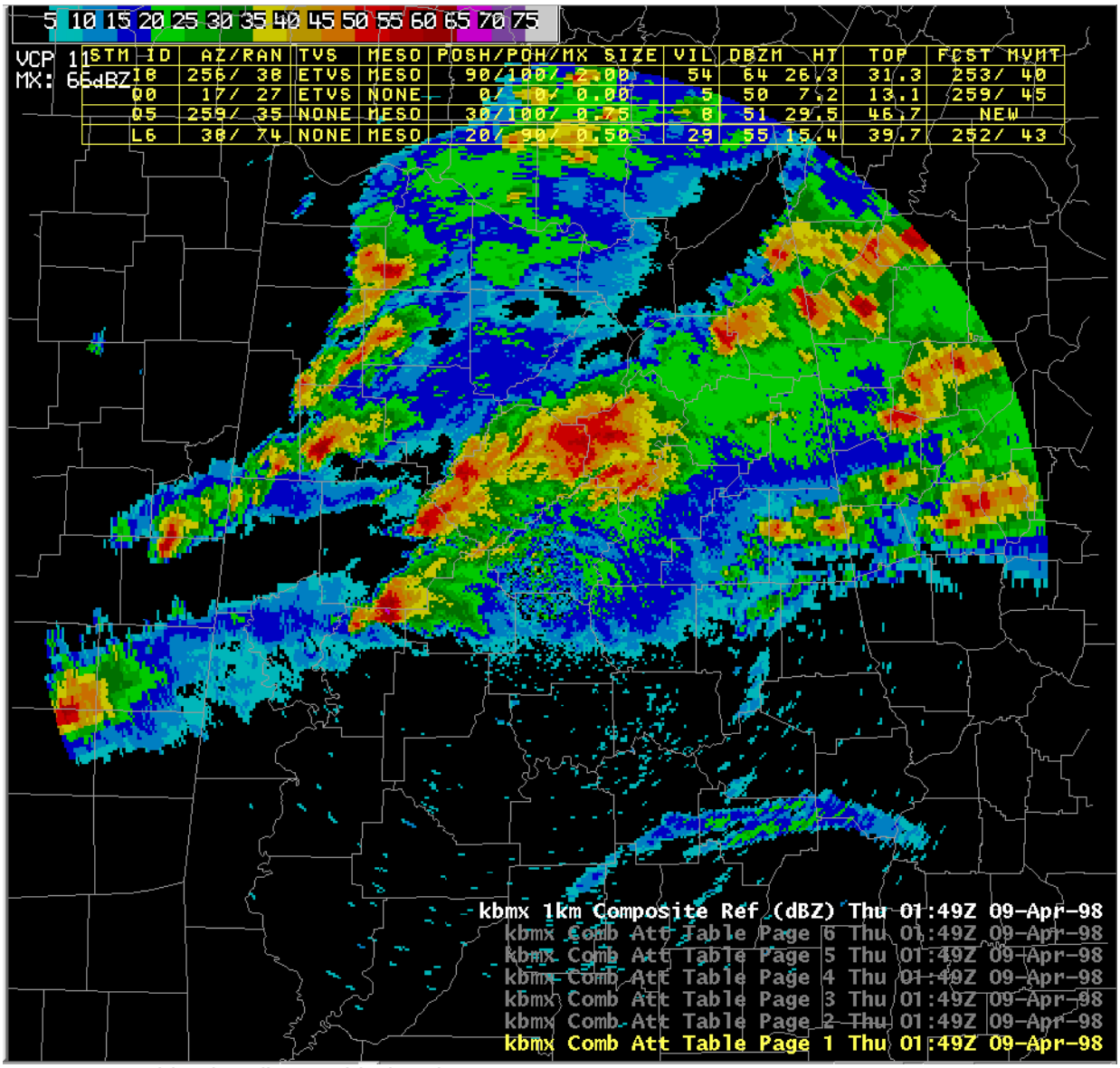


Figure 25. Combined Attribute Table (CAT)

The Digital Precipitation Array (DPA) product is now displayable on the WFO scale.

Radar Mosaics

The production and distribution of regional and national radar composites are another significant feature in Build 5.0. AWIPS will now generate and distribute a national radar composite (10 km resolution) every half-hour based on information provided in the Radar Coded Message (RCM) from every WSR-88D. This national composite graphic will contain ancillary information associated with the RCM, such as the echo top height, presence of hail, and cell/line movement.

AWIPS will also generate and distribute (via the SBN/WAN) state and local radar composites of the following product types:

- Base Reflectivity - 0.5° (1 km res)
- Hybrid Scan Reflectivity (2 km res)
- Vertically Integrated Liquid (4 km res)
- Echo Tops (4 km res)
- Composite Reflectivity (4 km res)
- Layer Composite Reflectivity - midlevel (4 km res)
- One Hour Precipitation (2 km res)
- Three Hour Precipitation (2 km res)
- User Selectable Precipitation (2 km res)
- Storm Total Precipitation (2 km res)
- Mesocyclone Graphic (2 km res)
- Hail Graphic (2 km res)
- TVS Graphic (2 km res)

All composite products except the Three Hour Precipitation (THP) and User Selectable Precipitation (USP) will be generated and displayed at 6 minute intervals. The THP will be available on the hour, and the USP product will be available every 6

hours. The 24-hour USP will be available once daily at 12Z.

These radar mosaics will be much better in Build 5.0 than in previous builds because they now will be based on the *best* resolution provided by the available products used in the composite. You can now identify which radar was used to provide data to the composite as well as the data value, elevation angle of the data point, nominal volume scan time, Z-R relationship used, and any Quality Control information available for that data, such as the SYSCAL value for the radar.

Satellite Enhancements

Build 5.0 Satellite Data Products

GOES Sounder Data will provide lots of new digital satellite data that will be included on the AWIPS Satellite Broadcast Network (SBN). Build 5.0 GOES Sounder Digital Product Imagery (DPI) will include the Lifted Index (LI), Total Precipitable Water (TPW) (see Fig. 26), cloud top pressure, and surface skin temperature.

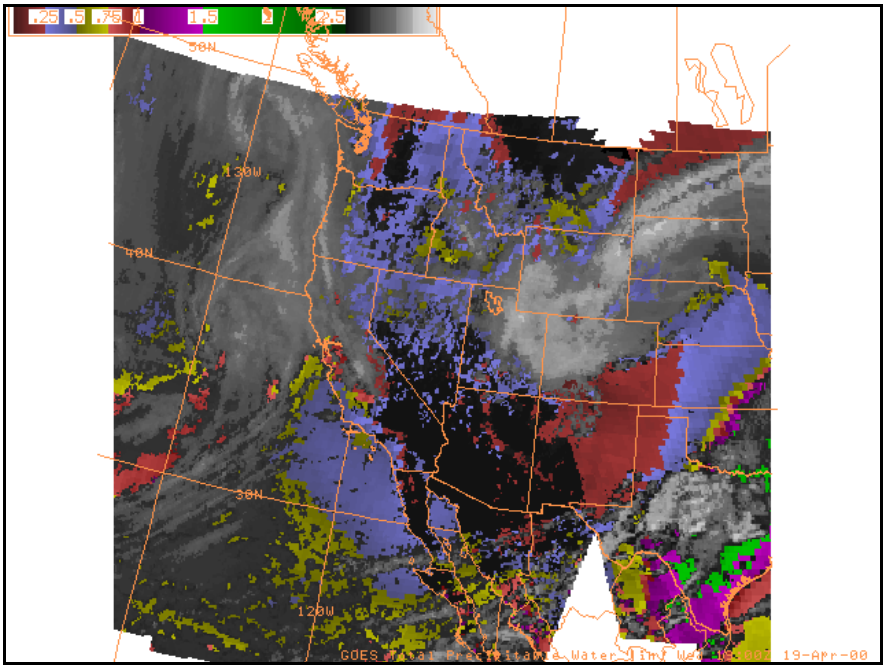


Figure 26. GOES Sounder Image of Total Precipitable Water.

The benefits of sounder data are that they provide hourly updates of important thermodynamic variables. A user can loop these data to help identify trends in stability, moisture, cloud conditions and surface temperature. In addition, the sounder data can be used to complement and validate similar data (LI, CAPE, CIN, PW, T, etc.) derived from other sources (e.g., radiosonde, profiler, models, and ASOS). The sounder data can be displayed from the satellite pull-down menu on the D2D workstation.

Future AWIPS Builds & SCAN Upgrades

Interactive Forecast Preparation System (IFPS)

The forecaster will be able to generate products such as digital forecast matrices using the IFPS. One of the main components in IFPS will be available in AWIPS Build 5.0 is the graphical forecast editor. For more information on IFPS see:

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http://www.nwstc.noaa.gov/d.train/IFPS.HTML
```

Deployment schedule linked to NWSTC Residential Training Course. Upon completion of the course, the focal point will receive the software for installation of the IFP portion of AWIPS Build 5.0. Therefore, deployment begins with the first course taught late January or early February 2000, and will continue through FY00.

Build 5.1.1 Enhancements of short-term forecasts and warnings

A number of radar enhancements are planned for AWIPS Build 5.1.1 including status of alerts, improved radar mosaics, high-resolution zoom applied to base data radar products all of the time, greater control over audible and visible alarms, and consistent distance units on cross section display.

Build 5.1.1 will also add satellite-based functionality including, interactive parallax adjustments, cloud top height computations, roamable Skew-T displayed over imagery and new satellite image visualization capabilities.

Additional functions for the warning environment will also be a storm spotter mapping capability, display of non-AWIPS generated mesoscale models, more storm-type related convective parameters to

the volume browser, new wind profiler products and new warngen tracking options.

New enhancements to SCAN will include storm relative helicity calculations, multi-radar-based products, data monitoring upgrades and WFO backup capabilities.

Deployment is expected in June 2000.

Open Radar Product Generator (ORPG)

The term “Open Systems” can be applied to many things, depending with whom you talk. In this context, it refers to the practices of:

a. Designing computing environments based on industry and government accepted standards that are vendor independent (that is, independent of which “brand” you choose to purchase), and

b. Purchasing “off-the-shelf” items not specifically designed for your application.

Further, an open system provides inter operability (meaning various systems should be able to “talk” to one another). It allows portability of software, data, and users (i.e. they can be transferred to other computer systems). Finally, an open system uses computer systems which are scalable (they can be upgraded as technology progresses instead of being replaced).

Build 5.1.2

As of the writing of this document enhancements to be included in Build 5.1.2 were still being defined. Deployment expected in November 2000.

Summary

SCAN/FFMP offers a flexible configuration of extensive displays of radar-derived parameters to assist the forecaster in short-term forecasting and warning situations. SCAN/FFMP incorporates cell table information and rankable features, rate-of-change alarms, time trends and many user friendly interfaces. SCAN and FFMP both utilize output from several algorithms. Thus, to adequately utilize SCAN/FFMP, forecasters must have a knowledge of the strengths and limitations of those algorithms. Since base data inspection is very important for the most timely and accurate warning decisions, SCAN/FFMP output can effectively be used as a "safety net" to alert forecasters to algorithm-identified severe storm attributes otherwise overlooked in the base data analysis.

Proper configuration of SCAN/FFMP products is crucial to effective utilization in warning decision operations. We have presented some suggestions of how to maximize performance of the software on the AWIPS workstation in a typical warning decision making situation.

Minimal operational experience is currently available in using SCAN 2.0 and FFMP. To ensure a broader working knowledge and appreciation in using this important operational warning tool, we would like to know of your experiences. Please send a short summary of using SCAN in warning operations to:

Warning Decision Training Branch
3200 Marshall Avenue, Suite 202
Norman , OK 73072

http://www.osf.noaa.gov/otb/otb.htm